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DIGITAL CHINA: POWERING THE ECONOMY TO GLOBAL COMPETITIVENESS

DECEMBER 2017

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MGI is led by three McKinsey & Company senior partners: Jacques Bughin, Jonathan Woetzel, and James Manyika, who also serves as the chairman of MGI. Michael Chui, Susan Lund, Anu Madgavkar, Sree Ramaswamy, and Jaana Remes are MGI partners, and Jan Mischke and Jeongmin Seong are MGI senior fellows.

Project teams are led by the MGI partners and a group of senior fellows, and include consultants from McKinsey offices around the world. These teams draw on McKinsey's global network of partners and industry and management experts. Advice and input to MGI research are provided by the MGI Council, members of which are also involved in MGI's research. MGI council members are drawn from around the world and from various sectors and include Andrés Cadena, Sandrine Devillard, Richard Dobbs, Tarek Elmasry, Katy George, Rajat Gupta, Eric Hazan, Eric Labaye, Acha Leke, Scott Nyquist, Gary Pinkus, Sven Smit, Oliver Tonby, and Eckart Windhagen. In addition, leading economists, including Nobel laureates, act as advisers to MGI research.

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DECEMBER 2017

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PREFACE

China is already a global leader in the digital economy. It is a major investor in and one of the world's leading adopters of digital technologies in the consumer sector. Chinese consumers are proving to be enthusiastic about all things digital, powering e-commerce and mobile payments. But there is much more to come. A new wave of digitization is now unfolding in which many more businesses put digital at the heart of their operations and strategy. As they do so, there will be significant restructuring in value chains, creative destruction leading to higher efficiency, and large productivity gains. As a result, China's economy will become more dynamic, and more Chinese businesses will be able to compete globally and even export "Made in China" digital business models and solutions.

MGI has undertaken wide-ranging research on the impact of digital technologies on China's economy. In this research, we have focused on how three digital forces—disintermediation, disaggregation, and dematerialization—are reshaping value chains and, in the process, boosting productivity. We examined in detail four very different sectors: consumer and retail, because it was one of the earliest to digitize in China; automotive and mobility, to test whether and how digitization can transform an advanced manufacturing sector; health care, because of its huge potential for digital disruption; and freight and logistics, because it is very inefficient and still relatively less digitized in China than elsewhere.

This research was led by Jonathan Woetzel, a McKinsey senior partner and a director of MGI based in Shanghai, and Jeongmin Seong, an MGI senior fellow in Shanghai. Also closely involved in this effort were James Manyika, chairman of MGI based in San Francisco; Kevin Wei Wang, a senior partner in McKinsey's Hong Kong office; and Michael Chui, an MGI partner based in San Francisco. We also thank Gordon Orr, a former McKinsey senior partner in China, for his thoughtful guidance throughout this research effort. Wendy Wong and Jonathan Kuo-Yanagawa led the research team, which comprised Karen Chen, Daniel Cheng, Yuan Hu, Tim Lin, Qu Qu, Feng Shi, Yingzi Tian, Mike Wang, Hank Yang, Qian Yao (alumnus), and George Zhao.

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This report contributes to MGI's mission to help business and policy leaders understand the forces transforming the global economy, identify strategic locations, and prepare for the next wave of growth. As with all MGI research, this work is independent and has not been commissioned or sponsored in any way by any business, government, or other institution. We welcome your comments on the research at MGI@mckinsey.com.

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IN BRIEF

DIGITAL CHINA

China is already a major player in digital technologies at home and around the world, and it has enormous growth potential. As digital forces shake the status quo and restructure value chains, an even more globally competitive Chinese economy and dynamic firms can emerge.

- China has become a leading global force in the digital economy. The country has 42 percent of global e-commerce, processes 11 times more mobile payments than the United States, and is home to one-third of the world's unicorns.
- Three factors suggest huge upside for China: a large and young Chinese market enabling rapid commercialization of digital business models; a rich digital ecosystem expanding beyond a few giants; and the government allowing space for digital companies to experiment, and being an investor in and consumer of digital technologies.
- The new MGI Industry Digitization Index for China reveals that a large gap vs. counterpart sectors in the United States has been closing rapidly. In 2013, the United States was 4.9 times more digitized than China; in 2016, that figure was 3.7 times.
- Three digital forces—disintermediation, disaggregation, and dematerialization—can potentially shift (and create) 10 to 45 percent of industry revenue pools by 2030. Disintermediation and disaggregation can have the largest impact.
  - **Consumer and retail.** Disintermediation (omnichannel, data-driven business models) is a major force for meeting evolving consumer demand. Disaggregation (sharing economy) and dematerialization (3-D–printed goods) can serve niche demand in specific categories. These forces can impact 13 to 34 percent of the industry revenue pool.
  - **Automotive and mobility.** Disintermediation (omnichannel, connected cars) enables technology suppliers and automakers to reach consumers directly, and disaggregation (shared-mobility solutions) may reduce demand for new car sales. Overall, digital forces can have an impact on 10 to 30 percent of the industry revenue pool.
  - **Health care.** Disintermediation (Internet of Things–and artificial intelligence–enabled solutions) can help to address chronic diseases, while disaggregation (health-care big data) can minimize overtreatment. There could be an impact equivalent to 12 to 45 percent of health-care expenditure.
  - **Freight and logistics.** Disintermediation (real-time matching platforms) can address industry fragmentation while disaggregation (crowdsourcing delivery) can enable flexible capacity. These forces could impact 23 to 33 percent of the revenue pool.
- China's government can enable digitization by continuing to be a major investor in, and consumer of, digital technologies, promoting healthy competition, managing labor markets as the economy transitions to digital, and contributing to the effort to reach consensus in the global debate on issues such as technology standards and digital sovereignty.
- Companies in China need to embrace digital even more than elsewhere because China's rapidly growing and changing economy will magnify gains for winners and risks for losers. They may consider six approaches: adopt bold strategies; use the power of China's vast ecosystem; maximize value from analytics by using China's massive data pools; build an agile organization; digitize operations; and engage with China's policy and regulation.

Digital China

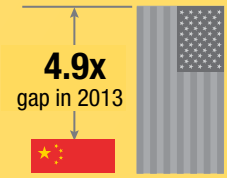
CHINA IS ALREADY A GLOBAL FORCE IN DIGITAL TECHNOLOGIES

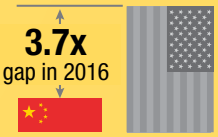
42%
share of global e-commerce transactions

34%
of global unicorns[1]

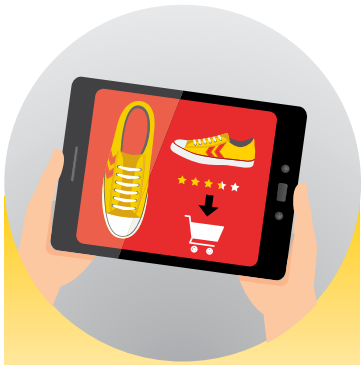
Top three
in the world for venture capital investment in emerging technologies[2]

IT LAGS BEHIND THE UNITED STATES ON THE DIGITIZATION OF ITS INDUSTRY, BUT IS CATCHING UP QUICKLY



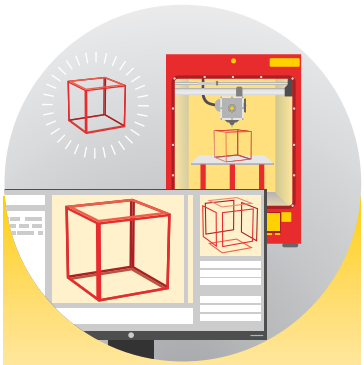


THREE DIGITAL FORCES CAN SHIFT (OR CREATE) 10–45% OF INDUSTRY REVENUE POOLS BY 2030



DISINTERMEDIATION
Using digital to cut out the middle man

DISAGGREGATION
Breaking up large items (cars, properties) and repackaging as services

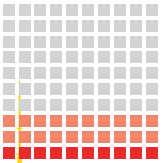


DEMATERIALIZATION
Turning the physical into the virtual (3-D printing, virtual reality)

THE POTENTIAL IMPACT OF THE THREE FORCES IN FOUR KEY SECTORS IS LARGE

CONSUMER AND RETAIL
13–34%

AUTOMOTIVE AND MOBILITY
10–30%



HEALTH CARE
12–45%

FREIGHT AND LOGISTICS
23–33%

GOVERNMENT CAN:
- Be a major investor in, and consumer of, digital technologies
- Promote healthy and dynamic competition
- Manage labor markets transition during digital disruption
- Reach global consensus on digital governance

BUSINESS PRIORITIES INCLUDE:
- Adopt bold strategies
- Use China's digital ecosystem
- Maximize value from China's massive data pool
- Build an agile organization
- Digitize operations
- Engage with policy and regulation

1 Defined as a privately held startup valued at over $1 billion.
2 Top three investor in technologies including big data, artificial intelligence and machine learning, wearables, virtual reality, autonomous vehicles, 3-D printing, robotics, and drones.

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EXECUTIVE SUMMARY

China has become a force to be reckoned with in digital at home and around the world. As a major worldwide investor in digital technologies and one of the world's leading adopters of the technologies, it is already shaping the global digital landscape and supporting and inspiring entrepreneurship far beyond its own borders.

But there is much more to come. As China digitizes, industries will experience huge shifts in revenue and profit pools across the value chain. This creative destruction is happening globally as the world digitizes, but it is likely to happen more quickly and be on a relatively larger scale in China given a combination of inefficiencies in traditional sectors and massive potential for commercialization.

In this report, the McKinsey Global Institute (MGI) assesses the strengths of China's digital system and the degree of digitization of industries. In order to understand how digitization is shaking the status quo and creating winners and losers, MGI looks at how three digital forces—disintermediation, disaggregation, and dematerialization—can restructure value chains and increase the magnitude of disruption. The research explores how policy makers can facilitate the transition toward a digital economy and what choices companies can make to prepare for the impending wave of change.

CHINA IS HOME TO DYNAMIC DIGITAL INNOVATORS AND IS A LEADING GLOBAL INVESTOR IN THE LATEST TECHNOLOGIES

China accounts for
>40%
of global
e-commerce

Conventional measures of digitization in China suggest that the nation is only in the middle of the pack. However, our view is that digital China is already more advanced than these measures suggest, and its potential is far larger than most observers realize.[1]

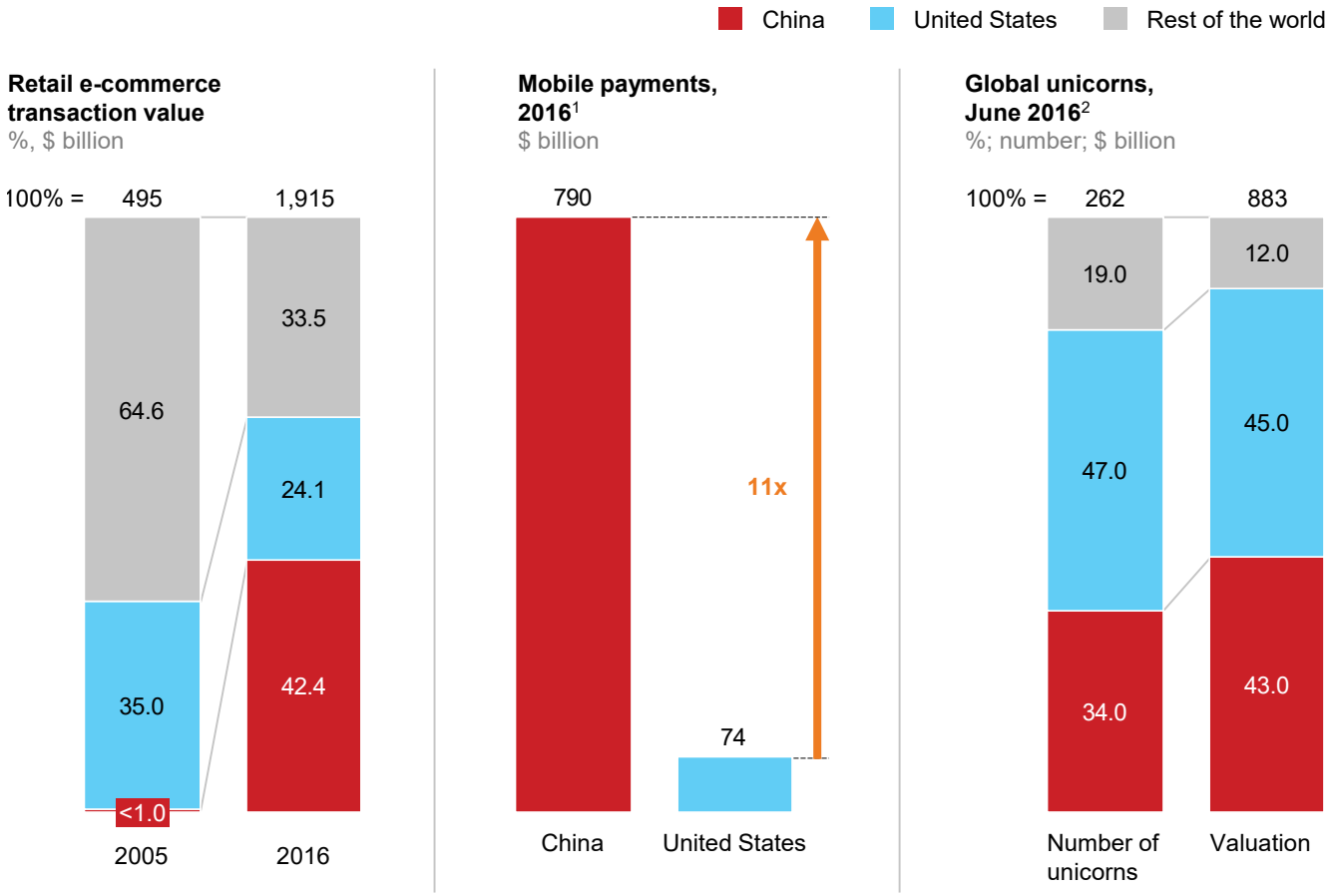
In e-commerce, China accounted for less than 1 percent of the value of worldwide transactions only about a decade ago; that share is now more than 40 percent. The current value of China's e-commerce transactions is estimated to be larger than in France, Germany, Japan, the United Kingdom, and the United States combined. Penetration of mobile payments among China's internet users grew from just 25 percent in 2013 to 68 percent in 2016. In 2016, the value of mobile payments related to individuals' consumption was $790 billion, 11 times that of the United States. One in three of the world's 262 unicorns is Chinese, commanding 43 percent of the global value of these companies (Exhibit E1).

China's venture capital industry is increasingly focused on digital. Overall, China's venture capital sector has grown rapidly, from just $12 billion, or 6 percent of the global total, in 2011–13 to $77 billion, or 19 percent of the worldwide total, in 2014–16. The majority of venture capital investment is in digital technologies such as big data, artificial intelligence (AI), and financial technology (fintech) companies. China is in the top three in the world for venture capital investment in key types of digital technology including virtual reality (VR), autonomous vehicles, 3-D printing, robotics, drones, and AI.

[1] China ranked 50th out of 131 countries on the 2016 Digital Adoption Index published by the World Bank, and 59th out of 139 on the World Economic Forum's Networked Readiness Index. The Digital Adoption Index is based on general digital business adoption, internet and mobile access for citizens, and online public services. The Networked Readiness Index is based on the macroeconomic environment, digital readiness and infrastructure, digital usage, and the economic and social impact of the network. These rankings tend to use national averages, and therefore do not fully capture powerful industry dynamics and consumer behaviors.

Exhibit E1

China's digital economy is a story of commercial success and investor excitement



1 Refers to third-party payments conducted through mobile transactions. For China, mobile payments exclude bank or UnionPay credit card transactions, digital wealth management, and digital finance. For the United States, payments are in-person payments on mobile between buyers and sellers, and remote payments on mobile devices.
2 Defined as a privately held startup valued at over $1 billion.
NOTE: Numbers may not sum due to rounding.

SOURCE: PitchBook; Dealogic; eMarketer; iResearch; TechCrunch CrunchBase Unicorn Leaderboard; McKinsey Global Institute analysis

Three factors suggest that there is huge upside for digital in China.

- **The big and young Chinese market is enabling rapid commercialization of digital business models on a large scale.** In 2016, China had 731 million internet users, more than the European Union (EU) and the United States combined; and 695 million mobile users (95 percent of total internet users), compared with 343 million in the EU (79 percent), and 262 million in the United States (91 percent). Nearly one in five internet users in China relies on mobile only, compared with just 5 percent in the United States. China's mobile share of e-commerce sales is around 70 percent vs. 30 percent in the United States; its share of internet users making mobile digital payments is around 68 percent vs. 15 percent in the United States.

- **Three of China's internet giants—Baidu, Alibaba, and Tencent, or BAT—are building a rich digital ecosystem that is now growing beyond them.** The BAT companies have built strong market positions by taking out inefficient, fragmented, and low-quality offline markets. These companies started with an anchor offering and then diversified. Players like Alibaba's Alipay and Tencent's WeChat now offer "superapps," which give consumers a one-stop shop covering education, health, information services, entertainment, e-commerce, and social interactions. The big three have been powerful

enablers, providing 42 percent of Chinese venture capital investment in 2016. One in five top Chinese startups was founded by BAT or BAT alumni, and an additional 30 percent receive funding from BAT firms. Large incumbents such as Ping An and Huawei are also building their own ecosystems that go beyond their traditional industries.

- **The government gave digital players space to experiment before enacting official regulation, and it is becoming an active supporter.** The Chinese government moved to regulate the digital sector only after a delay. While consumer protection may sometimes have been weak, this approach gave innovators space to experiment. For example, regulators took 11 years after Alipay introduced online money transfers in 2005 to set a cap on the value of such transfers. Today, the government is actively building world-class infrastructure to support digitization as an investor, developer, and consumer.

With these factors, the impact of digital China on the global economy has been increasing. China ran an annual surplus in digital services of $10 billion to $15 billion over the past five years. Its outbound venture capital totaled $38 billion in 2014–16, or 14 percent of global venture capital investment outside China, up from $6 billion, or 4 percent, in 2011–13. Over the past two years, China's top three internet companies made 35 overseas deals, compared with 20 by the top three US internet companies. China is also exporting digitally driven business models and enabling foreign partners.

CHINESE INDUSTRIES LAG BEHIND THEIR COUNTERPARTS IN ADVANCED ECONOMIES ON DIGITIZATION, BUT THE GAP IS RAPIDLY CLOSING

US industries were **3.7x** more digitized than those in China in 2016, vs. **4.9x** in 2013

China is already a global leader in the consumer-driven digital economy. The next wave of digital transformation in China is likely to come from broader adoption of digital technologies by businesses in different sectors that will restructure value chains and boost productivity.[2] The new MGI Industry Digitization Index for China assesses where its sectors stand on digitization relative to each other and reveals that Chinese industries are at very different stages (Exhibit E2).[3]

Overall, digitization of industries in China still lags behind that of the United States by a considerable margin, but that gap is narrowing rapidly. In 2013, the United States was 4.9 times more digitized than China; in 2016, that figure had fallen to 3.7 times.

The index reveals five clusters of sectors that are at similar stages of their digitization. As in other economies, the most digitized sectors in China include information and communications technologies (ICT), media, and finance (Cluster 1). In ICT, China's internet companies are rapidly ramping up investment in digital infrastructure. To give an idea of the size of this investment, demand for servers from China's tech giants is as large as the entire national demand of countries such as Brazil and South Korea. Chinese semiconductor companies have been automating and digitizing facilities to serve global customers. Another pattern that is similar to those in other economies is that the sectors that lag furthest behind are fragmented and localized industries such as real estate, agriculture, local services, and construction (Cluster 5). However, even in lagging sectors, digital solutions are penetrating. In real estate, for instance, digital companies such as Anjuke.com and Fang.com offer real-time house listings for sale and rent. Residential-property company Vanke's mobile app offers services including property maintenance. Small and fragmented local services

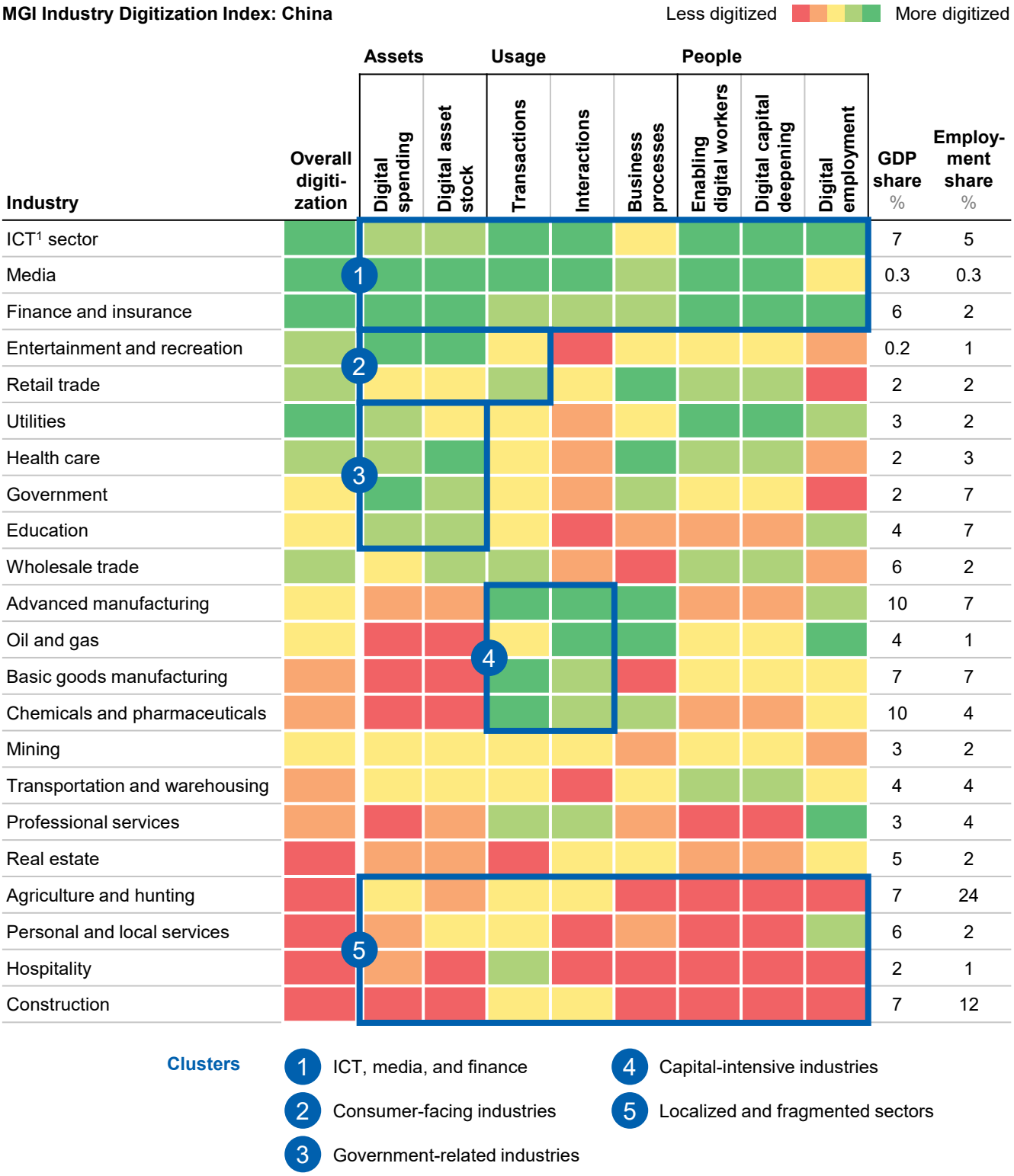
[2] *China's digital transformation: The internet's impact on productivity and growth*, McKinsey Global Institute, July 2014.

[3] We analyzed 22 industries on 25 indicators, and used this analysis to calculate the index on three dimensions: assets, their use, and labor. To quantify where different Chinese sectors stand on digitization, we used MGI's methodology in previous research on digitization in the United States and Europe. See *Digital America: A tale of the haves and have-mores*, McKinsey Global Institute, December 2015; and *Digital Europe: Pushing the frontier, capturing the benefits*, McKinsey Global Institute, June 2016.

companies such as restaurants and household-management businesses are benefiting by participating in digital platforms even if they don't invest heavily in digital assets themselves.

Exhibit E2

MGI Industry Digitization Index: China



1 Information and communications technology.

SOURCE: Gartner; Kable; OECD; Central Bureau of Statistics; Bloomberg; McKinsey Global Institute analysis

2-3x
higher growth in profit margins in the most digitized sectors vs. the least digitized

China's consumer-facing industries (Cluster 2) and sectors associated with government (Cluster 3) rank higher relative to other sectors compared with their counterparts in the United States and Europe. Chinese consumers are enthusiastically embracing digital technologies, and the industries that serve them have had to respond by investing in digital assets and processes. In entertainment, more than half of event tickets were sold through digital channels in 2016 (75 percent in the case of movies), according to iResearch estimates. In retail, about 45 percent of retailers had developed online sales channels by 2016, up from just 25 percent in 2014, according to the China Internet Network Information Center. There has been massive investment in government-associated sectors, too. In utilities, China was already the world's largest market for smart grids by investment in 2013. In 2015, about 310 million households were using smart meters, a penetration rate of more than 80 percent, compared with 56 percent in 2013, research shows. Spending on IT solutions by health-care institutions has increased rapidly, from 15 billion renminbi ($2.3 billion) in 2011 to an estimated 34 billion renminbi ($5 billion) in 2016, annual growth of 18 percent. In education, increased spending has ensured that 87 percent of all elementary and middle schools in China have internet access today.[4] The number of monthly users of online education platforms is now 170 million in the case of children's education, 95 million for foreign language learning, and 45 million for professional education.[5]

MGI's research on digitization in the United States and Europe has found that firms in the most digitized sectors tend to be more profitable. In the United States, average profit margins in the most digitized sectors grew two to three times as much as those of less digitized sectors over the past 20 years. MGI's Industry Digitization Index for China reveals a similar overall picture. Sectors that have a high degree of digitization tend to post faster growth in labor productivity than those that are less digitized.

THREE DIGITAL FORCES CAN POTENTIALLY SHIFT (AND CREATE) 10 TO 45 PERCENT OF THE INDUSTRY REVENUE POOL ACROSS PLAYERS BY 2030

As China digitizes, industries will experience huge shifts in revenue and profit pools across the value chain, doubtless involving a degree of disruption that will create losers and winners—and disproportionate value for the latter.[6] Digital is causing creative destruction around the world, but this phenomenon is on a relatively larger scale in China due to a combination of the rapid pace of economic growth and changes in the economy, the prevalence of inefficiency across sectors, and massive potential for commercialization at scale.

We looked in detail at four sectors that offer different opportunities: consumer and retail; automotive and mobility; health care; and freight and logistics. We analyzed about 300 use cases in these four sectors, and assessed how the three major digital forces can reshape the value chain and improve productivity (see Box E1, "Three digital forces").

4 *13th Five-Year Plan for educational informationization*, Ministry of Education, June 7, 2016 (http://www.moe.gov.cn/srcsite/A16/s3342/201606/t20160622_269367.html).

5 *China online education market overview for Q1 2017*, China Internet Watch, May 16, 2017.

6 Jacques Bughin, Laura LaBerge, and Anette Mellbye, "The case for digital reinvention," *McKinsey Quarterly*, February 2017.

Box E1. Three digital forces

Disintermediation. This is a major trend in China. Alibaba and others have disrupted the retail industry by cutting out a middle layer and linking suppliers and consumers directly through digital platforms. Industries with high margins on offline channels, a lack of information transparency due to multiple layers between suppliers and customers, and a highly fragmented landscape are ripe for this type of digital disruption.

Disaggregation. Digital attackers are disrupting traditional business models and reinventing industries by disaggregating huge assets into many pieces, turning them into services, and serving fragmented consumer bases. Industries that have high value, high durability, and fluctuating utilization are the main territory for this type of disruption. Digital disruption through disaggregation is increasingly prominent in China, shared mobility being a prime example.

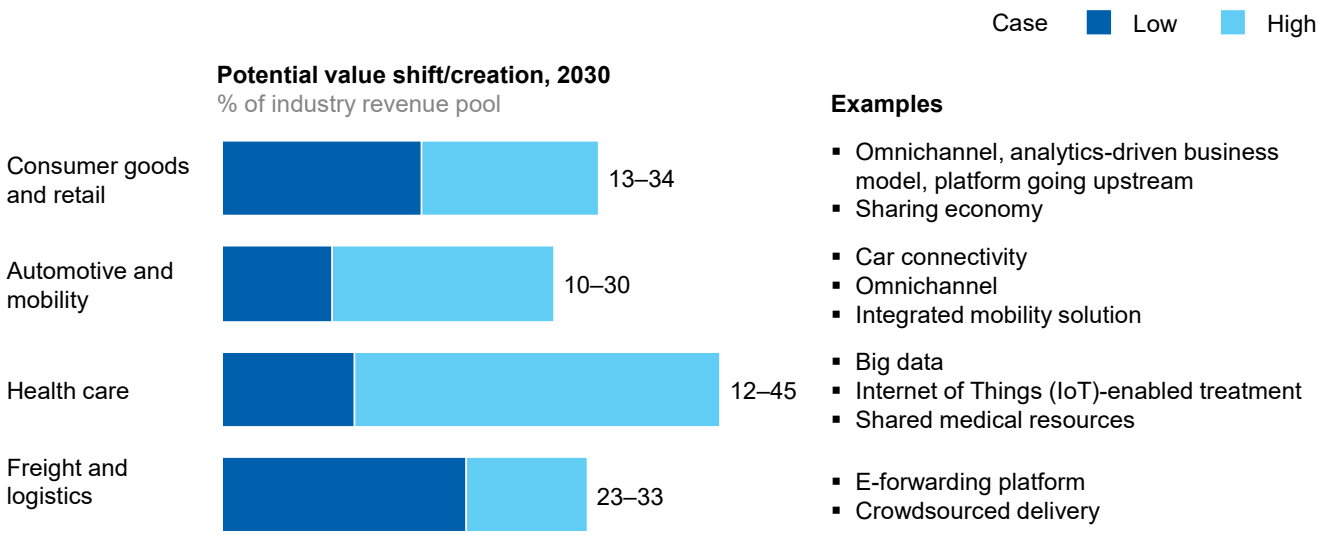
Dematerialization. This digital force changes products or processes from physical to virtual, unbundling demand with digital delivery and enabling consumers to receive products or services anywhere, anytime. In China, the pace of this conversion has been faster than elsewhere in categories such as music and e-books, and the upside for digital attackers far larger than in other countries.

Our simulation suggests that by 2030, digitization can potentially shift, and create, value equivalent to 10 to 45 percent of the industry revenue pools in the four sectors analyzed (Exhibit E3). Digital forces will shift value from old business models to new ones, from slow-moving incumbents to nimble digital attackers, and from one part of the value chain to another. For large traditional companies, this means that a substantial portion of their revenue could be at risk, lost to new products, services, and business models from digital attackers. This is especially the case if incumbents operate in vulnerable areas of the value chain and industries and companies are slow to react due to organizational inertia. Nevertheless, they can actively embrace digital, offer digital solutions, and become sources of new competition, too.

Exhibit E3

Digital forces can shift (and create) between 10 and 45 percent of the industry revenue pool across players by 2030

SIMULATION



SOURCE: McKinsey Global Institute analysis

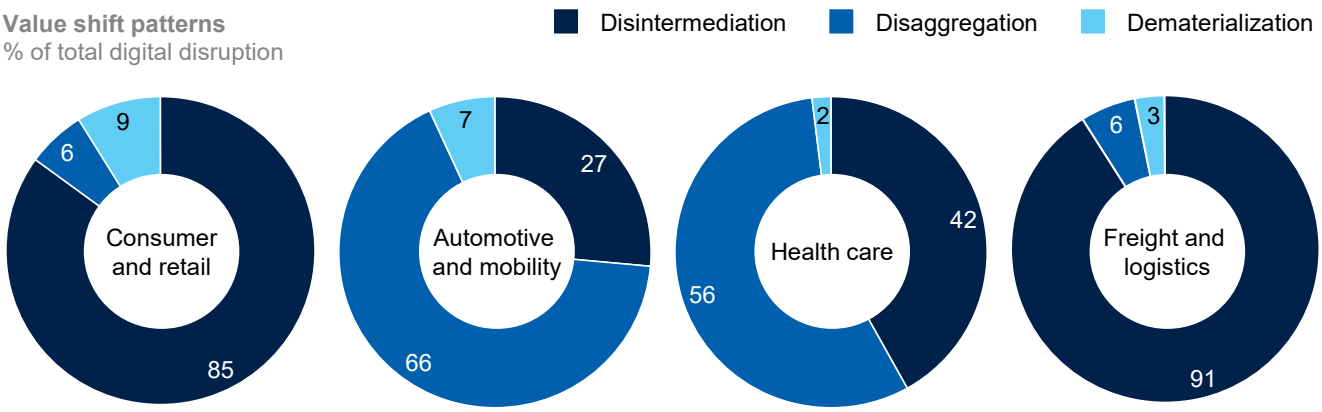
The pattern of impact of the three digital forces varies according to the sector. Overall, however, of the three digital forces restructuring value chains, disintermediation and disaggregation are the two largest in the four sectors we looked at in detail. In both cases, digital platforms play an important role by directly matching fragmented suppliers and customers, a function that can substantially improve transparency across the value chain, while offering multisided solutions that enable the rapid expansion of supply and cater to underserved demand. Dematerialization (we focused on physical dematerialization in this research, but acknowledge that such dematerialization also leads to virtualization of services) has the smallest overall impact in our simulation (Exhibit E4).

Exhibit E4

Disintermediation and disaggregation are the major forces in value-chain restructuring

HIGH SCENARIO

Value shift patterns
% of total digital disruption



SOURCE: McKinsey Global Institute analysis

Consumer and retail: Digital is reshaping the retail experience for customers

Digitization in China thus far has largely been driven by the e-commerce revolution, but we expect an even more significant transformation to unfold in the years ahead. Our simulation finds that digitization can shift—and create new value—on the order of 13 to 34 percent of the industry revenue pool. The major force in play in shifting and creating value is disintermediation. In addition to continued growth of e-commerce as online sales penetrate further into rural areas, into smaller cities, and across borders, three additional trends are unfolding and transforming this sector.

The first trend is the continued evolution of an integrated omnichannel experience for consumers that mixes offline and online. According to the 2017 McKinsey China iConsumer Survey, an overwhelming majority of shoppers in China—85 percent—are already omnichannel consumers. Broadly, offline is shifting from being a primary sales channel to a shopping "experience." In the consumer-electronics category, shoppers who performed online research while visiting a retail outlet bought the same brand they originally had in mind more than 80 percent of the time. Therefore, brands and retail companies need to pay close attention to shaping the omnichannel experience. It offers huge room to experiment and improve. About 60 to 70 percent of shoppers surveyed said that they were excited about omnichannel services such as online-to-offline (O2O) product pickup, QR code-scan payments, product-return services, and VR experiences at offline stores. Nevertheless, only 10 to 25 percent of shoppers surveyed said that they had actually used these offerings. Consumer goods and retail companies need to take this into account if they are to retain their existing customers and maximize unexplored selling potential. As the traditional e-commerce business model becomes commoditized, digital attackers also have an incentive to experiment with new retail models.

The second trend is toward data-driven business models that can more effectively serve Chinese consumers who increasingly want to buy higher quality and customized products and services. With technology as an enabler, digital media, social networking, and search engines give content away. Therefore, consumer-goods and retail companies can monetize much more consumer data, understand customers' behavior and sentiment in real time, and influence consumer decisions more than ever before. Analytics and digital connections with consumers are enabling the emergence of new customer-to-business solutions that engage customers directly and gather their data so that orders can be customized. Chinese companies are increasingly adopting the model: one yogurt company takes into account recommendations from its customers when developing a new flavor or packaging, an apparel company has a customized manufacturing solution, and a furniture company has a tailored design solution.

The third trend that may unfold in China (as it is elsewhere) is that digital platforms go upstream as they accumulate know-how and own their consumer relationships. Observers have long been skeptical about online platforms moving beyond their core businesses, but it is happening. In the United States, for instance, Netflix is now producing its own content, and Amazon has launched private labels since 2004. In both cases, the platforms acted in an attempt to broaden their business and strengthen their relationships with consumers.

The impact of disaggregation (the sharing of goods and services, and the rental of second-hand or used goods) and dematerialization is relatively small in consumer and retail at a combined 2 to 5 percent of revenue. These forces are likely to occur as companies meet demand in specific categories and niche markets.

60%
of Chinese survey respondents say owning a car is no longer a status symbol

Automotive and mobility: Digital is transforming the future of transportation

The digitization of cars is gathering pace, and digital solutions will reshape the mobility of China, which is the world's largest automotive market but faces a range of economic and social issues, including urban traffic congestion and air pollution. Our simulation finds that digitization can shift and create value equivalent to between 10 and 30 percent of the automotive industry revenue pool.

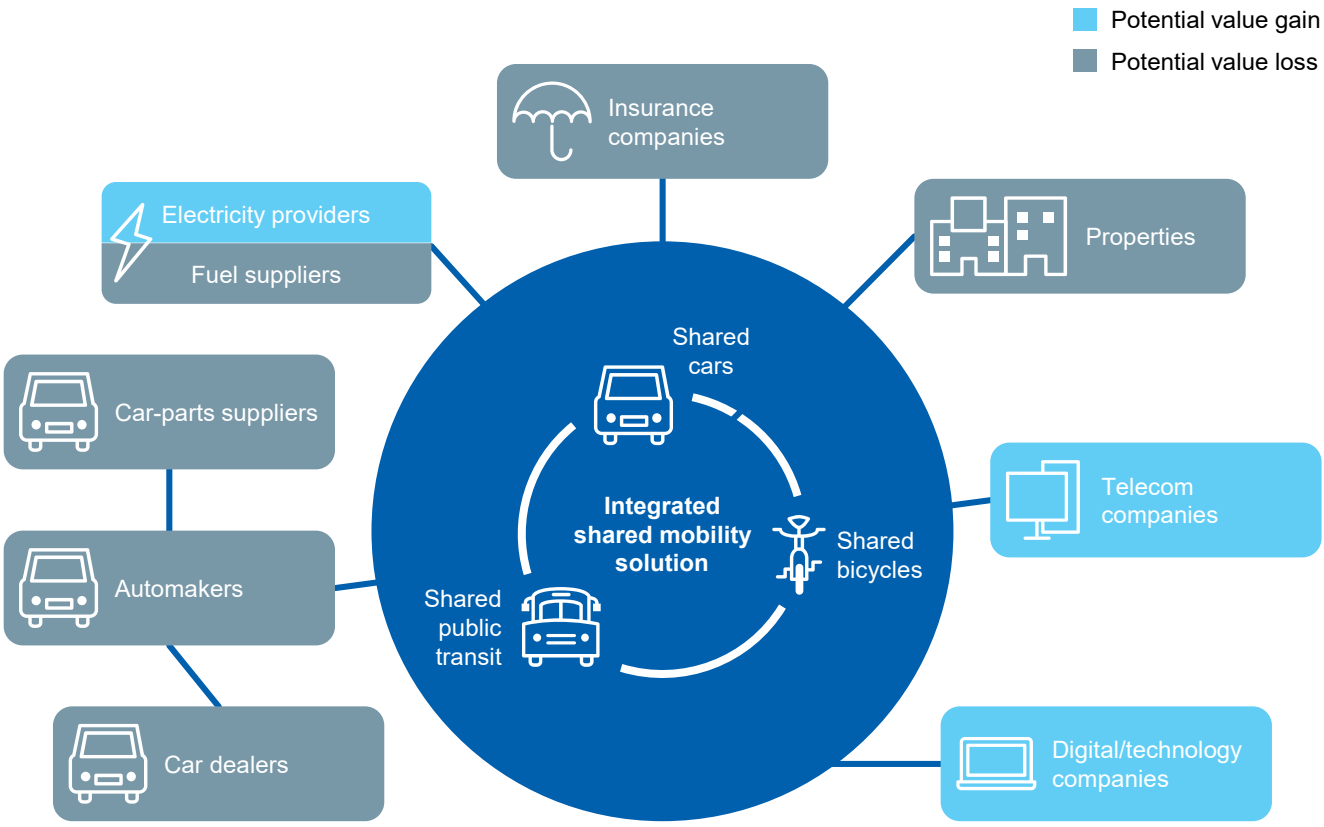
Disaggregation, notably through shared mobility, can facilitate an ongoing shift from an ownership model to a service-driven one. The dominant shared-mobility model today is ride sharing, but there is a move toward integrated solutions that link passenger cars, public transit, and last-mile solutions such as bicycles that will transform the way people move. According to the 2016 McKinsey China Auto Consumer Survey, 60 percent of respondents said that owning a car was no longer a status symbol, and 42 percent said that owning a car was less appealing today because of high maintenance costs and worsening traffic congestion.[7] This can create ripple effects on original equipment manufacturers (OEMS), dealers, suppliers, and providers of digital mobility solutions, as well as governments, insurance companies, energy providers, and suppliers of technology (Exhibit E5).

Disintermediation enables OEMs and component and technology suppliers to establish direct relationships with consumers, influencing their decisions. Using omnichannel approaches, OEMs can serve consumers directly, in the process obtaining valuable firsthand insights into their purchasing preferences. In an extreme case, the entire consumer decision journey—searching for a vehicle, test-driving it, paying for it, and obtaining after-sales service—could be digitized.

[7] The China Auto Consumer Survey interviewed more than 3,500 consumers in order to measure changing consumer behavior and attitudes toward cars. See *Finding the fast lane: Emerging trends in China's auto market*, McKinsey & Company, April 2016.

Exhibit E5

Integrated mobility solutions can fundamentally change how people move and create ripple effects in adjacent industries



Consumer attitudes toward car ownership are changing

60% In contrast to before, owning a car is no longer a status symbol

40% I can live without a car and I can rent when I need a car

Shared mobility solutions are penetrating rapidly

30% E-hailing or car-sharing penetration

67% 17-minute decrease in commuting time

SOURCE: McKinsey China Auto Consumer Survey 2016; China Shared Economy Survey 2017; McKinsey Global Institute analysis

Car connectivity can enable component suppliers or providers of technology solutions to bypass OEMs and establish direct relationships with customers through offerings such as in-car entertainment, operating systems, and other value-added services; again, having a direct line to customers means that these companies can influence their decisions. Survey evidence suggests that Chinese consumers are not only eager to adopt all that connected cars have to offer but are also willing to pay for those features. In the 2016 McKinsey Car Data Monetization Survey, 68 percent of Chinese respondents said that connected entertainment features were relevant and that they were willing to try them, compared with 34 percent in the United States and 21 percent in Germany.

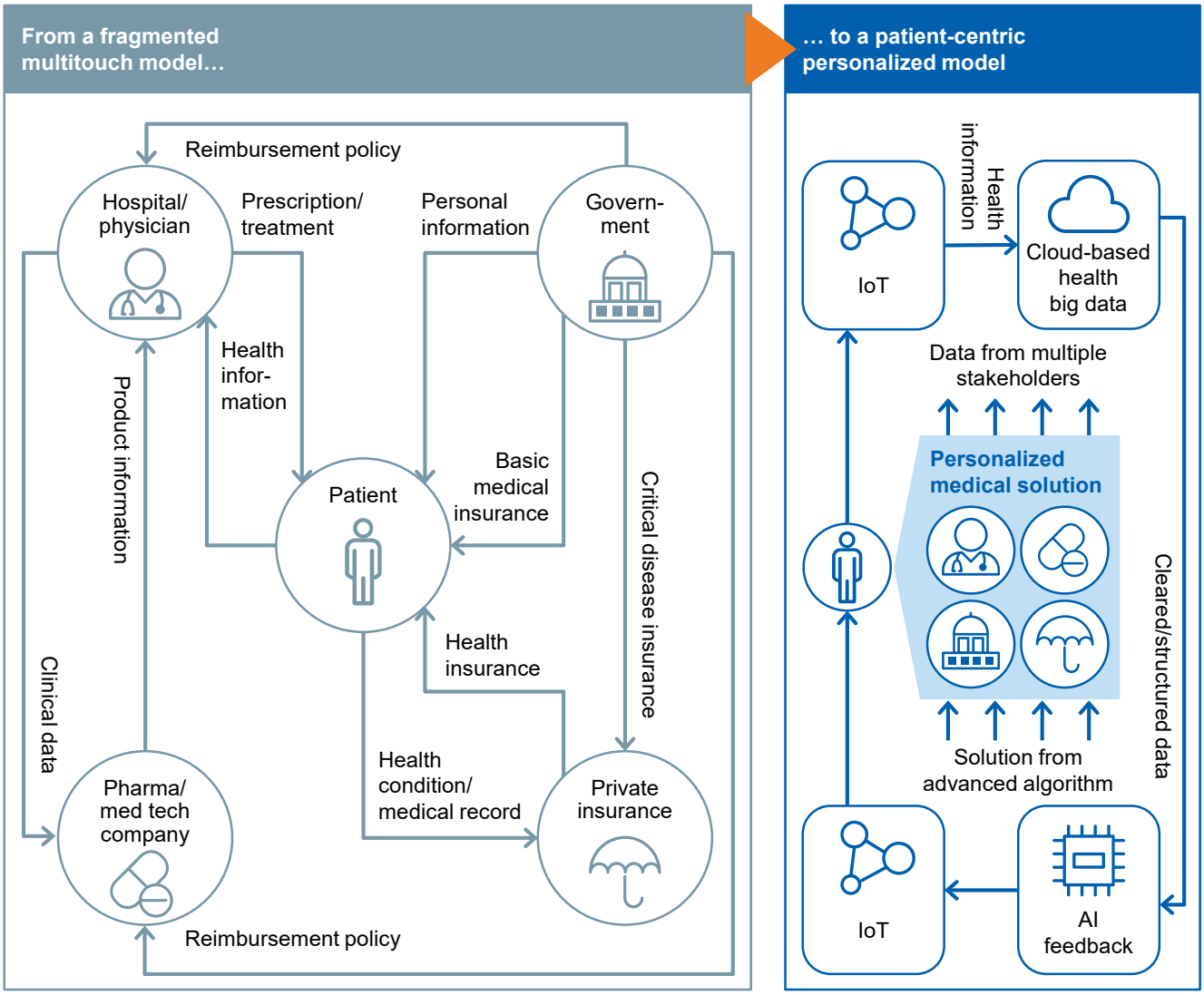
Health care: Digital solutions can be used to build a patient-centric system

China has substantially improved its health-care services, especially since the reforms of 2009. Health-care spending has been growing five to ten percentage points faster than GDP over the past decade, and today the health-care system covers 95 percent of the population. However, the system still faces a range of challenges, and digital technologies can help to address them. Our analysis finds that digitization can shift and create new value

on the order of 12 to 45 percent of health-care spending. If a big-bang scenario were to happen, combining significant developments such as health-care big data, AI-empowered treatment, and Internet of Things (IoT)–enabled services, the impact could be the largest of the four sectors we analyzed and, in the process, usher in a more efficient system in which the patient is at the very center (Exhibit E6).

Exhibit E6

In a big-bang scenario, the patient becomes the center of digital health care



SOURCE: McKinsey Global Institute analysis

Disintermediation includes IoT and remote monitoring, AI-enabled care, and e-commerce. IoT solutions can help address China's chronic and non-communicable diseases. China is home to an estimated 260 million patients with chronic diseases, and this number is likely to continue to increase. Chronic disease is estimated to cause 85 percent of all deaths in China.[8] Wearables, mobile health-care apps, and telemedicine solutions can help users be more aware of health issues at an earlier stage to help them prevent illnesses from emerging or deteriorating. AI-enabled digital solutions are another way for health-

[8] See *Nutrition and chronic conditions of Chinese residents report*, National Health and Family Planning Commission, June 30, 2015; Angela Wang, "Chronic diseases cause 85 percent of deaths in China, says report," *The Epoch Times*, July 10, 2012; and *Global status report on noncommunicable diseases 2014*, World Health Organization, 2014.

care providers to provide more consistent and timely diagnosis and treat patients more directly and accurately. Some evidence shows that diagnosis is sometimes inadequate in China, overtreatment occurs, and that there is huge variation in the quality of health-care provision among different regions and types of hospital and clinic.[9] One study found that village doctors asked their patients only 18 percent of essential questions, correctly diagnosed just 26 percent of unstable angina cases, and dispensed medication that was either unnecessary or harmful in 64 percent of cases.[10] Finally, there is huge potential for e-commerce and business-to-business (B2B) sales of drugs in China given how many layers of transactions there are. The country recently introduced a "two-invoice system" that will reduce the number of steps it takes for hospitals to procure drugs from manufacturers, currently five to eight, to no more than two, helping to reduce highly inflated drug prices by a considerable margin.

Disaggregation in health care centers on efforts to consolidate fragmented data and medical resources, and then monetize them by disaggregating them into services that offer improved diagnosis and treatment, improved access to patients, and higher utilization rates of facilities. Medical data in China are currently segregated in data "islands" within each hospital or health-care institution. The degree of digitization is low. As of 2015, about 29 percent of hospitals in China had not installed electronic medical records systems, compared with only 4 percent in the United States in 2014, for example.[11] Health-care big data could generate substantial value for different players in the sector. Medical-technology and pharmaceutical companies could improve the productivity of their R&D and offer personalized medicine for patients. Health insurance companies can substantially reduce waste from fraud and overtreatment due to information asymmetry. With big-data analytics, they can cross-check claims data with clinical data and analyze billing patterns, and therefore help to identify inappropriate payments. With better understanding of patients, companies can encourage behavioral changes that could cut the cost of insuring them. Zhong An Insurance, the first online-only insurer in China—which is a joint venture of Alibaba, Tencent, and Ping An—is exploring the use of big data in its product development and claims management. Using a connected glucose meter, the company has designed a system of rewards and penalties for those people it insures that improves their compliance with treatment and therefore the outcome of that treatment.[12]

Freight and logistics: Players can reach customers faster and cheaper through digital

China's traditional freight and logistics sector faces significant challenges. The cost of logistics as a percentage of GDP is around double the figure in the United States. Higher costs in China reflect the industry's inefficiencies caused by fragmentation of the sector, operational shortcomings, and relatively limited competition in certain segments. Our simulation finds that digitization can shift and create value equivalent to between 23 and 33 percent of the industry's revenue pool.

Disintermediation (or digital intermediation) can boost efficiency, particularly in highly fragmented industries. In China's road-transportation industry, about 95 percent of the approximately eight million registered trucking companies or individual truckers are small and medium-sized concerns.[13] Managing freight transit with such a large number of self-

9 *Healthy China: Deepening health reform in China: Building high-quality and value-based service delivery*, policy summary, China Joint Study Partnership, 2016.

10 Sean Sylvia et al., "Survey using incognito standardized patients shows poor quality care in China's rural clinics," *Health Policy and Planning*, volume 30, number 3, March 20, 2014.

11 Electronic medical records are a digital version of traditional paper-based medical records for an individual, such as medical history, diagnoses, medications, and allergies.

12 *Product update of Doctor Tang*, Huanqiu, September 14, 2016 (http://tech.huanqiu.com/internet/2016-09/9441274.html).

13 *Transportation statistics bulletin of the China Road Transport Association*, CRTA, May 12, 2016 (http://www.crta.org.cn/article-2349.html).

employed or small enterprises adds operational complexities. Another challenge is the fact that participants in this sector lack transparent, real-time information on routing, which leads to many trips by empty trucks. In China, the average empty running ratio in road transportation is about 40 percent, far higher than 10 to 15 percent in the United States and Germany. Online platforms that connect business users with truck companies or individuals have enormous power to disintermediate small traditional trucking companies. Ymm56 offers real-time matching in trucking services and integrates receipts, loans, and other financial services into its offering; the company has 850,000 registered shippers and three million heavy truck drivers on its platform.

31B
packages by express delivery in 2016, from
0.3B
a decade earlier

Disaggregation can address challenges in express delivery. The annual volume of express delivery in China soared to 31 billion packages in 2016, from 0.3 billion only a decade earlier. In addition, consumers expect goods to be delivered more quickly. As demand fluctuates significantly between peak and off-peak times, and labor costs rise rapidly in China, it is even more important for express-delivery companies or e-commerce delivery units to be efficient and flexible in their deployment of delivery drivers. There are now platforms that crowdsource delivery drivers, including Dada (later merged with JD Daojia), Shensong, and Fengniao Delivery.

Dematerialization driven by 3-D printing, e-working, and paperless solutions can reduce the flow of goods, but its impact is likely to be relatively small compared with the other two forces.

BUSINESSES CAN IMPROVE PRODUCTIVITY BY DIGITIZING THEIR OPERATIONS

In addition to restructuring value chains, adoption of digital technologies by businesses can boost sector productivity and generate impact equivalent to between 3 and 14 percent of the industry revenue pool. Some digital tools boost top-line growth, and others reduce cost. There is a significant opportunity for Chinese companies both to catch up with best practices and to use the strengths of China's digital ecosystem.

In consumer and retail, we estimate that the adoption of digital solutions (including big data analytics, smart customer relationship management, and IoT) can improve productivity by 3 to 10 percent of the size of the industry revenue pool. In automotive, digital in manufacturing (customized R&D, the digitization of supply chains, and smart manufacturing), marketing and services (precision marketing and smart pricing), and the back office (digitization of human resources and IT functions) could boost productivity by between 5 and 14 percent of the size of the industry revenue pool. In health care, digital levers (such as clinical decision support systems, information sharing, ratings and review platforms, online health communities, the use of radio-frequency identification technology in the pharmaceutical industry, and online digital learning platforms) can help companies in China save costs equivalent to between 3.0 and 5.5 percent of health-care expenditure. In freight and logistics, digital solutions (for example, yield management and dynamic pricing, real-time track and trace, optimized routing using advanced analysis, and autonomous trucking) could boost the productivity of the sector by the equivalent of 4 to 9 percent of the industry revenue pool.

Applying digital levers will boost companies' competitiveness. We note, however, that not all savings will go to the bottom line—as market competition intensifies, at least some of those savings will need to go to consumers.

China's labor supply expected to fall from

773M

to

757M

by 2030

POLICY MAKERS CAN CONTINUE TO FACILITATE THE DIGITAL ECONOMY IN A NUMBER OF WAYS

Local and national governments in China have already done a significant amount to encourage the expansion of the digital ecosystem. They can continue to act in four areas.

- **Continue to be an important investor in, and consumer of, digital technologies and infrastructure.** The government can create a market for frontier technologies such as robotics and AI, encouraging long-term investment and innovation by companies, and continue to invest in expanding the infrastructure needed to address the divide between China's digital haves and have-nots. Digitizing government operations could make a substantial contribution to China's consumption of digital technologies.[14]

- **Promote dynamic and healthy competition to fuel innovation and serve the interests of consumers.** Although market concentration enables these digital giants to invest at scale in cutting-edge technologies such as AI and autonomous driving, there are concerns about whether the emerging phenomenon of digital monopolies offers a good deal to consumers. Legal debates about antimonopoly measures have arisen in China in relation to security software and shared mobility, for example. It is therefore important to ensure that the government acts to counter any abuse of market power, and to ensure dynamic and healthy competition through legislation and ensuring that entry barriers are low so that new players can compete with incumbents. Opening up government data can be another initiative to set a level playing field.

- **Manage labor markets during digital disruption.** Job churn will inevitably increase as new digitized sectors undermine traditional ones. In our base-case simulation, we found that 176 million to 253 million jobs can be created due to macroeconomic factors, and 161 million to 281 million jobs can be destroyed due to digital forces and automation.[15] Given that China's labor supply might decline from 773 million today to 757 million by 2030, the digital shock to the labor market appears manageable—as long as an effective program is in place, and government, companies, and individuals all contribute to making the transition as smooth as possible. Government can support lifelong learning and can reform education to help people equip themselves with the right skills while improving job-deployment programs and increasing labor mobility to ease friction during the transition.

- **Contribute to global debates on digital governance to reach consensus.** As digital technologies sweep through the global economy, there is intense debate about how to react to and govern the digital world. It benefits all governments to collaborate on issues such as cybersecurity, digital standards, intellectual property rights, and digital sovereignty. China is already involved in many discussions on such issues, and it should continue to play its full part to reach global consensus.

[14] China ranked 63rd of 193 countries on the United Nations' e-government index in 2016. It was seven places higher than in 2014 but still far below regional neighbors South Korea (third) and Singapore (fourth). See *United Nations e-government survey 2016: E-government in support of sustainable development*, Department of Economic and Social Affairs, United Nations, 2016.

[15] Our simulation of job creation is based on seven macroeconomic factors including rising income and demographic changes. Our simulation of job destruction is based on the three digital forces and automation. The simulation does not estimate total job turnover in the economy.

China's labor productivity only

15–30%

of OECD average

BEST PRACTICES SUGGEST SIX PRIORITIES FOR BUSINESSES AS CHINA DIGITIZES

Given the scale of China and the pace of transformation into a digital economy, companies that are slow to respond face a great risk of being left behind. Conversely, widespread inefficiencies in China's sectors and huge opportunities for commercialization mean those that act boldly can reap considerable rewards. McKinsey's experience working with companies around the world suggests that six approaches would be effective in China.

- **Adopt bold strategies.** Previous MGI research has found that bold, large-scale responses to digital disruption pay off three times as much as less aggressive reactions.[16] Widespread inefficiencies in China's sectors (where labor productivity is only 15 to 30 percent of the Organisation for Economic Co-operation and Development [OECD] average) suggest very large upside potential for disrupters. Companies can assess their vulnerability to the three digital forces and determine whether they want to play offense or be "fast followers"—moving when circumstances warrant doing so. Companies need to be prepared to disrupt their own business models in order to compete with attackers and actively develop new customers in new business areas. They should seek to be the default choice for customers in order to avoid being disintermediated by platforms or algorithms.

- **Use the power of China's vast digital ecosystem.** The influence of digital giants is bigger in China than in other economies because they not only have massive user bases, but also are active investors and providers of cross-sector digital solutions. Companies can be in a stronger position if they are part of an ecosystem, if necessary by creating their own. Companies should consider how best to collaborate with large digital platforms. The number of collaborations is growing. Examples include a cosmetics company that has shortened time to market by using Alibaba transaction data, an automotive company delivering targeted ads through WeChat, and a bank using Baidu map data for its branch expansion. Companies can also look at creating their own digital ecosystems in areas where large incumbents can still have natural advantages such as industry networks and expertise, especially in B2B areas.

- **Maximize value from analytics by using China's massive data pools.** Gathering and using data is increasingly a core competitive advantage for companies. China is superbly positioned because of the huge scale of data gathered every day. There are also arguably more opportunities to monetize data given that Chinese consumers are more willing to share their data than many of their international counterparts. To make the best use of data and analytics, companies can start by establishing the business imperative for gathering and analyzing data, deploying clear use cases to ensure that the CEO and top executives (and not just the IT department) support the effort. They need also to break down silos so that data can be shared across the organization, and actively look at ways to monetize them.

- **Build an agile organization for digital transformation.** Digital disruption is accelerating, and businesses need to be agile to respond rapidly. Chinese companies tend to be hierarchical, which arguably makes them inflexible. One way to address this is to reorganize in smaller teams. ING, for instance, put together 350 nine-person squads, and Haier restructured itself into microenterprises. Digital transformation needs the support of the CEO and top executives, a chief digital officer to lead the effort, and development of the right skills.

[16] In a McKinsey survey of C-suite executives around the world that captured responses from 2,000 traditional firms in more than 60 countries, 90 percent of companies said they were engaged in some form of digitization, but only 16 percent of them had responded boldly and at scale. See Jacques Bughin and Nicolas van Zeebroeck, "The best response to digital disruption," *MIT Sloan Management Review*, summer 2017, April 6, 2017.

- **Digitize operations based on a solid transformation program.** The scope for transformative digitization programs in Chinese companies is extremely large given the fact that the economy is still growing robustly, digital technologies are transforming the economy so quickly, and so many businesses are unprepared. The largest impact can be achieved through a comprehensive and structured transformation program.

- **Engage with China's policy and regulation.** The government has made it clear that digitization of the economy is a major priority. It is in companies' interest to keep abreast of policy and regulatory developments, understand how they may affect business, and determine what business opportunities may be available from working with government, as many companies involved in smart-city projects are already doing. More than 300 Chinese cities have signed construction contracts with IT companies.

•••

China is already a considerable global force in digital, and there is huge further scope to use digital technologies to transform the economy at home and influence the global digital landscape. China's internet giants have established strong positions in their respective markets and China's digital ecosystem is broadening; leading traditional companies are driving their digital transformations, building their own ecosystems, and going global; China's strong manufacturing base is spurring innovation in hardware and connectivity. Sectors that today are fragmented and inefficient can become streamlined and highly productive if the full power of digital is unleashed. The scope for very large value shifts and creation is substantial. A combination of wide-ranging inefficiencies across sectors, enthusiasm among Chinese consumers to embrace digital tools, and massive potential for commercialization points to further digitization in China on a truly enormous scale that can have a major impact on the global digital landscape. China's digital globalization is just getting started.

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1. CHINA'S DIGITAL ECONOMY: A LEADING GLOBAL FORCE

China is already more digitized than many observers appreciate. The country is one of the world's largest investors in and adopters of digital technologies, and is home to one-third of the world's unicorns.[17] China has the scale to drive rapid commercialization of digital business models and has the advantage of a very large home market of consumers who are young and eager to embrace digital in all its forms. Three aggressive internet companies with global reach—Baidu, Alibaba, and Tencent, or BAT as they are collectively known—are creating a multifaceted and multi-industry digital ecosystem that touches every aspect of consumers' lives. The government is actively encouraging digital innovation and entrepreneurship by giving companies room to experiment and offering support as an investor, developer, and consumer of new technologies.[18] China's digital transformation is already having a profound impact on its own economy, and is likely to have increasing influence on the worldwide digital landscape. China's digital globalization is only just getting started and is gathering momentum. Through mergers and acquisitions (M&A), investment, the export of new business models, and technology partnerships, China could set the digital frontier for the world in the coming decades.

CHINA IS HOME TO DYNAMIC DIGITAL INNOVATORS AND IS A LEADING GLOBAL INVESTOR IN THE LATEST TECHNOLOGIES

Conventional measures of China's development and adoption of digital technologies suggest that, so far, it is only in the middle of the global pack. China ranked 50th out of 131 countries on the 2016 Digital Adoption Index published by the World Bank, and 59th out of 139 on the World Economic Forum's Networked Readiness Index.[19] These rankings tend to use national averages and therefore do not fully capture powerful industry dynamics and consumer behaviors that are rapidly propelling China to becoming one of the world's leading digital players. Our view is that these rankings indicate vast potential rather than any structural deficit, and that the opportunity for China in digital is far larger than many observers suggest.

China is already a global leader in e-commerce and digital payments, and is home to one-third of the world's unicorns

11x
value of mobile payments in China vs. the United States

Over the past decade, China has become a leading global force in several areas of the digital economy. In e-commerce, for instance, only about a decade ago China accounted for less than 1 percent of the value of worldwide transactions; that share is now more than 40 percent. The value of China's e-commerce transactions today is estimated to be larger than the value of those of France, Germany, Japan, the United Kingdom, and the United States combined. Some early investors in leading Chinese e-commerce players are estimated to have earned returns of thousands of times their initial investment. In mobile payments, penetration among China's internet users has grown rapidly, from just 25 percent in 2013 to 68 percent in 2016. In 2016, the value of China's mobile payments related to consumption by individuals was $790 billion, 11 times that of the United States. Small

[17] Unicorns are defined as privately held startups valued at over $1 billion.

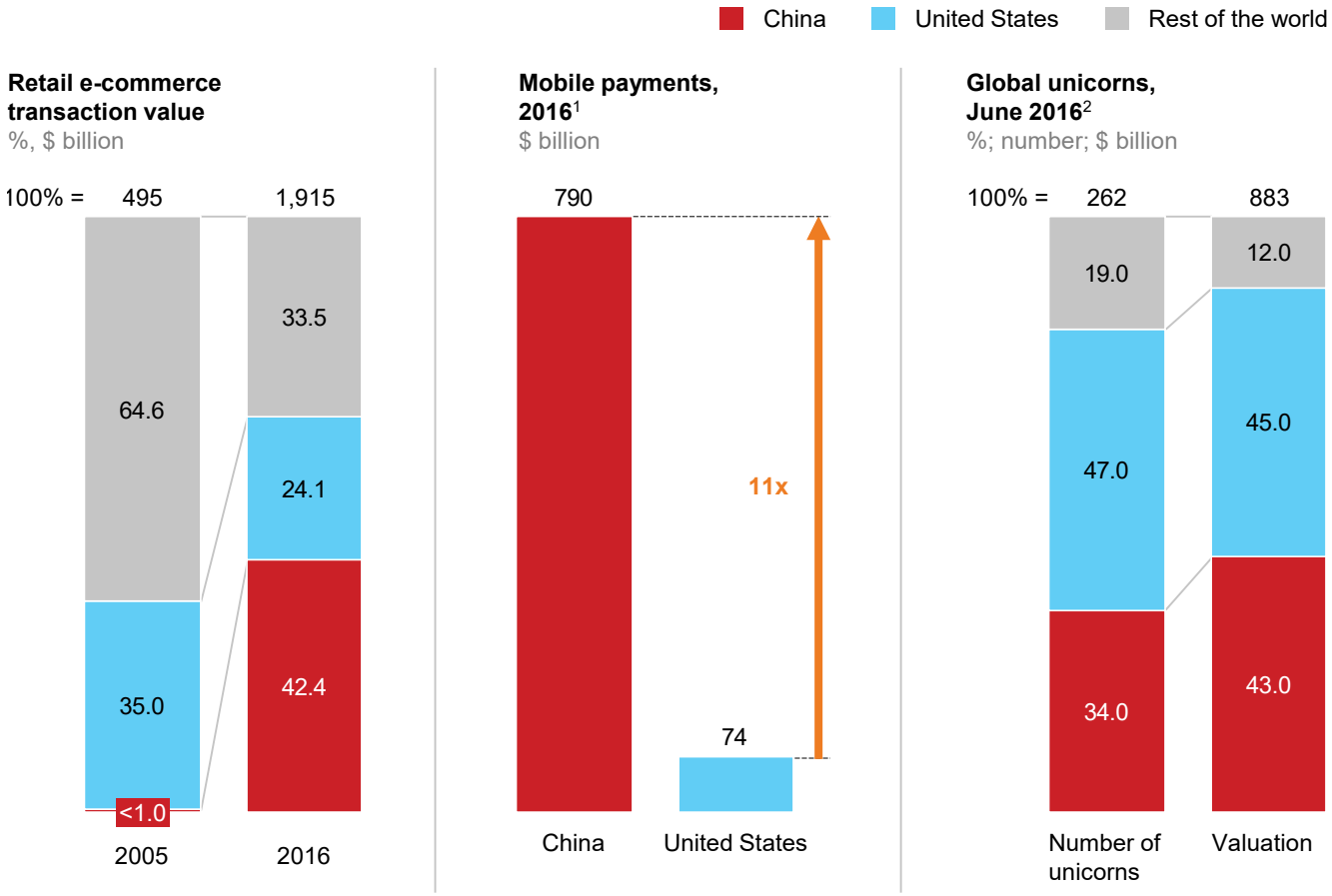
[18] MGI research in 2015 found that China has been rapidly improving its performance on innovation in customer-focused and efficiency-driven industries, but that it still has gaps to close in science- and engineering-based innovation, which is arguably more challenging. However, even in these latter types of innovation, China is improving its performance and experimenting with novel approaches. See *The China effect on global innovation*, McKinsey Global Institute, October 2015.

[19] The Digital Adoption Index is based on general digital business adoption, internet and mobile access for citizens, and online public services. The Networked Readiness Index is based on the macroeconomic environment, digital readiness and infrastructure, digital usage, and the economic and social impact of the network.

increases in penetration make a large difference given the sheer scale of the market. In digital payments, a one percentage point conversion into mobile of bank-card transactions (again related to consumption by individuals) can boost their value by more than $80 billion. Investors are enthusiastic and tend to have high expectations about the growth potential of China's startups. In the fintech category, nine of the 23 privately held unicorns in the world are based in China, and they account for more than 70 percent of the total valuation of fintechs worldwide. One in three of the world's 262 unicorns is Chinese, commanding 43 percent of the global value of these companies (Exhibit 1). As an illustration of the excitement among investors about the potential of some of China's digital players, consider that the combined valuation of two Chinese bicycle-sharing companies of around $6 billion is higher than that of the top two airline companies in South Korea, at about $5 billion.

Exhibit 1

China's digital economy is a story of commercial success and investor excitement



1 Refers to third-party payments conducted through mobile transactions. For China, mobile payments exclude bank or UnionPay credit card transactions, digital wealth management, and digital finance. For the United States, payments are in-person payments on mobile between buyers and sellers, and remote payments on mobile devices.
2 Defined as a privately held startup valued at over $1 billion.
NOTE: Numbers may not sum due to rounding.

SOURCE: PitchBook; Dealogic; eMarketer; iResearch; TechCrunch CrunchBase Unicorn Leaderboard; McKinsey Global Institute analysis

China is one of the leading global investors in digital technologies

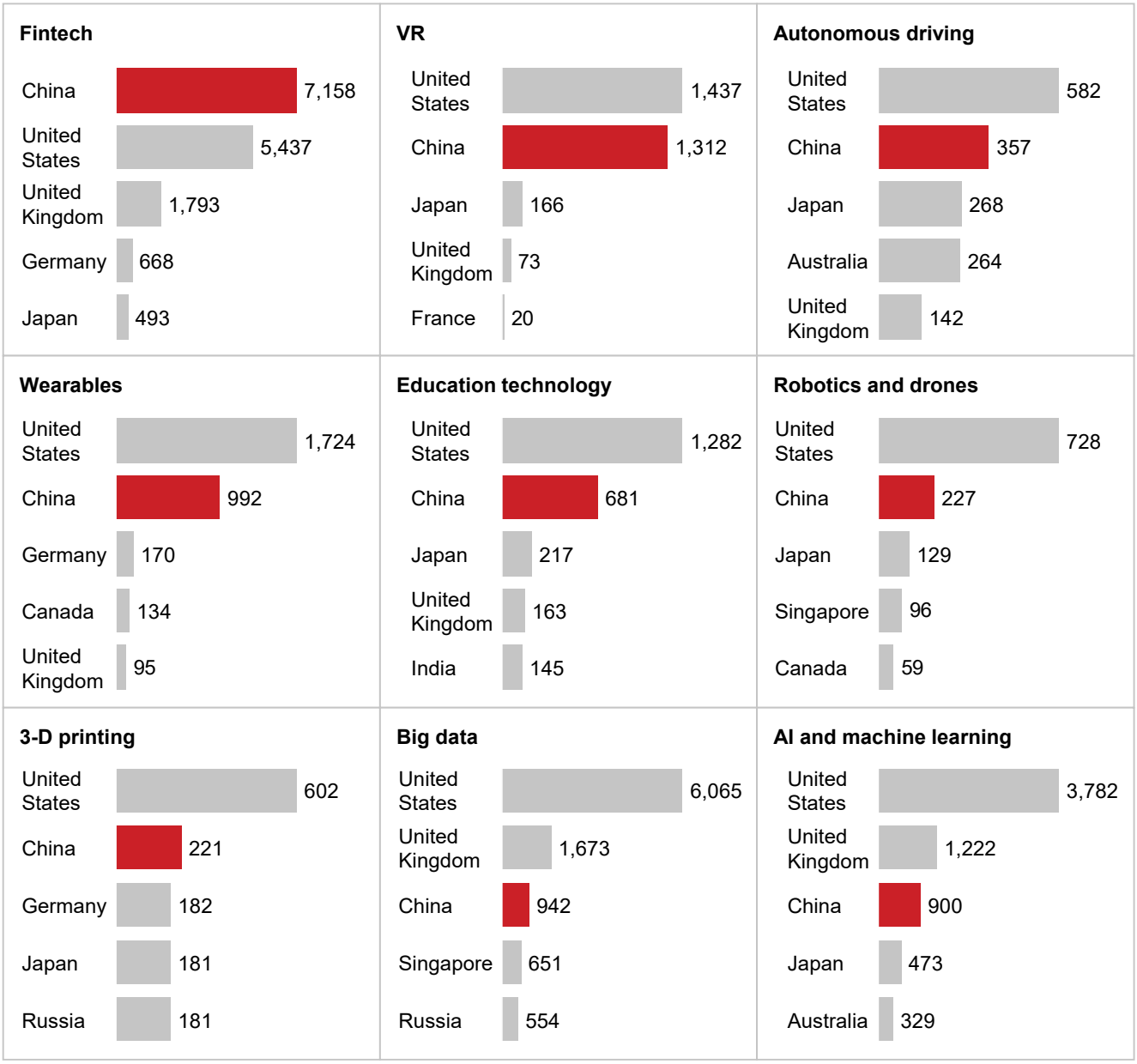
China has one of the most active digital investment and startup ecosystems in the world. Its growing venture capital industry is increasingly focused on digital. Overall, China's venture capital sector has been expanding rapidly, from just $12 billion in 2011–13, or 6 percent of the global total, to $77 billion in 2014–16, or 19 percent of the worldwide total. The majority

of venture capital investment is in digital technologies such as big data, AI, and fintech companies. China is in the top three in the world for venture capital investment in key types of digital technology, including virtual reality (VR), autonomous vehicles, 3-D printing, robotics and drones, and AI (Exhibit 2).[20]

Exhibit 2

China is in the global top three for venture capital investment in key technologies

Venture capital investment in leading technologies, 2016[1]
$ million



1 Based on the nationality of the investor. Coinvested deals are counted under each nationality. Investments in startups with multiple technologies are counted in each category of technology.
NOTE: Not to scale.

SOURCE: PitchBook; McKinsey Global Institute analysis

[20] AI-led automation can give the Chinese economy a boost to productivity that could add 0.8 to 1.4 percentage points to annual GDP growth, depending on the speed of adoption, MGI research finds. See *Artificial intelligence: Implications for China*, McKinsey Global Institute discussion paper, April 2017.

THREE (OFTEN UNAPPRECIATED) FACTORS SUGGEST THAT THERE IS HUGE UPSIDE FOR DIGITAL IN CHINA

China's digital potential is enormous—and far larger than many observers appreciate. We are optimistic for three reasons. First, China's large home market offers powerful scale advantages and extremely enthusiastic digital natives (aged 25 or under), both of which will continue to enable rapid commercialization of digital technologies. Second, competition is fierce in a rich ecosystem that was initially built around the BAT companies but is now spreading and deepening. Third, government regulators initially left space for innovators to flourish, and they now provide support for China's burgeoning digital sector by facilitating investment in, and adoption of, the latest technologies.

Factor 1: The young Chinese market is enabling rapid commercialization of digital business models on a large scale

731M
internet users in China—more than the EU and the United States combined

The sheer scale of China's internet user base encourages continuous experimentation and enables digital players to achieve economies of scale quickly. However, the strength of China's digital consumers goes beyond the advantages of scale—it also reflects the fact that the country's consumers are embracing digital technologies with a passion. Their enthusiasm supports growth in the market now and into the future, facilitates rapid adoption of innovation, and makes Chinese digital players and their business models competitive.

In 2016, China had 731 million internet users. That's more than the EU and the United States combined. China also has 695 million mobile users (95 percent of total internet users), compared with 343 million in the EU (79 percent) and 262 million in the United States (91 percent). Digital native internet users number about 282 million, nearly the same as the total number of US internet users. China's large user base of mobile and young people enables faster adoption of digital (Exhibit 3).

Chinese internet users tend to use mobile as an integral part of their daily lives. Nearly one in five internet users in China relies on mobile only, compared with just 5 percent in the United States. The mobile share of e-commerce sales stands at around 70 percent in China, compared with around 30 percent in the United States; the share of internet users in China making mobile digital payments is around 68 percent, compared with only around 15 percent in the United States. Chinese users spend ten hours longer each month on social apps than their US counterparts. According to the 2017 McKinsey Chinese iConsumer Survey, an estimated 31 percent of WeChat users have shopped on the platform in 2017, compared with just 13 percent in 2015.[21] The same survey indicates that 83 percent of Chinese internet users used O2O services—which drive digital customers to brick-and-mortar businesses—compared with 41 percent in 2015.

Cities also contribute to China's scale advantages. The country has 22 cities with populations of more than five million, compared with just one in the United States and four in the EU. The large scale and dense populations of China's cities attract investors and entrepreneurs, and enable a great deal of digital experimentation. In 2016, $20.9 billion of venture capital investment poured into Beijing, compared with $3.4 billion that went to London, $3.0 billion to Los Angeles, and $1.0 billion to Berlin, according to PitchBook. Many of China's regions are as digitized as those of other major economies, if not more. For instance, in Beijing and Shanghai, over 90 percent of households had access to the internet in 2016, around the same as in New York and somewhat higher than in San Francisco (88 percent).[22] The number of rides in Beijing through ride-hailing apps is estimated to be about eight times the number in New York. Chinese cities are hotbeds of digital innovation, and the scale of urban China fuels O2O consumption. In Shanghai, Ele.me, one of the

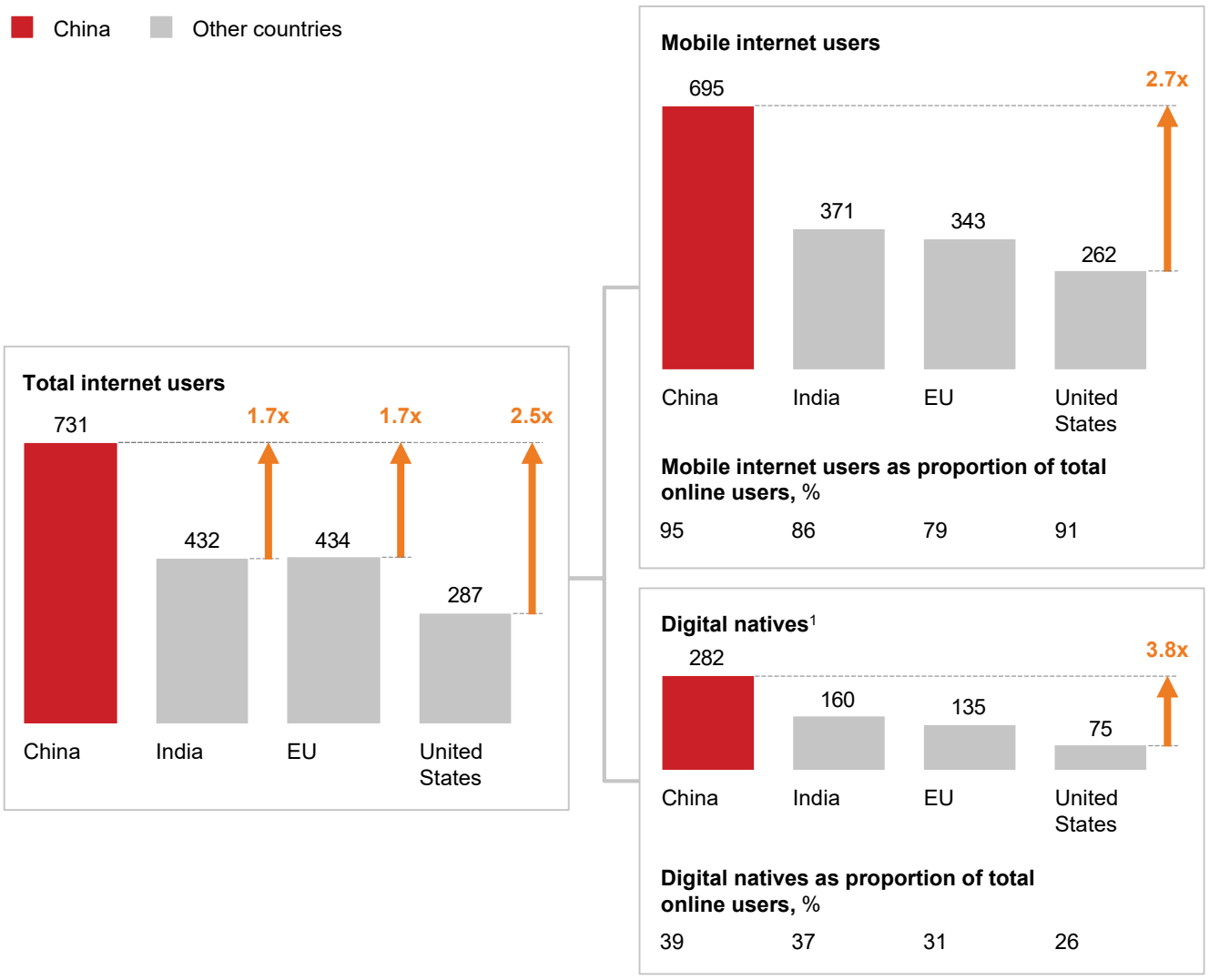
[21] For more detail, see *Redefining customer experiences for China's new retail era*, McKinsey & Company, June 23, 2017.
[22] Passbook.

largest online food-ordering platforms in China, is reported to have delivered an estimated 200 million orders in 2016—equivalent to about 10 percent of total digital orders, including delivery and in-store pickups, in the United States.[23]

Exhibit 3

China enjoys scale advantages, with a base of 695 million mobile users and 282 million digital natives

Million, 2016



1 Defined as internet users aged 25 or under.

SOURCE: China Internet Network Information Center; Internet & Mobile Association of India; World Bank; Statista; Internet Live Stats; McKinsey Global Institute analysis

Scale enables the development of unique solutions

The scale of mobile and digital use in China poses unique challenges to the country's digital players. For instance, the combined effect of heavy promotion by e-commerce companies on specific dates and the huge number of internet shoppers in China means much greater volatility in demand—the variation between peak and off-peak demand for e-commerce transactions is around 11 times, compared with three times in the United States. It is therefore vital to develop solutions to manage dramatic surges in demand. One example of a demand spike is China's annual Singles Day on November 11, which has become a

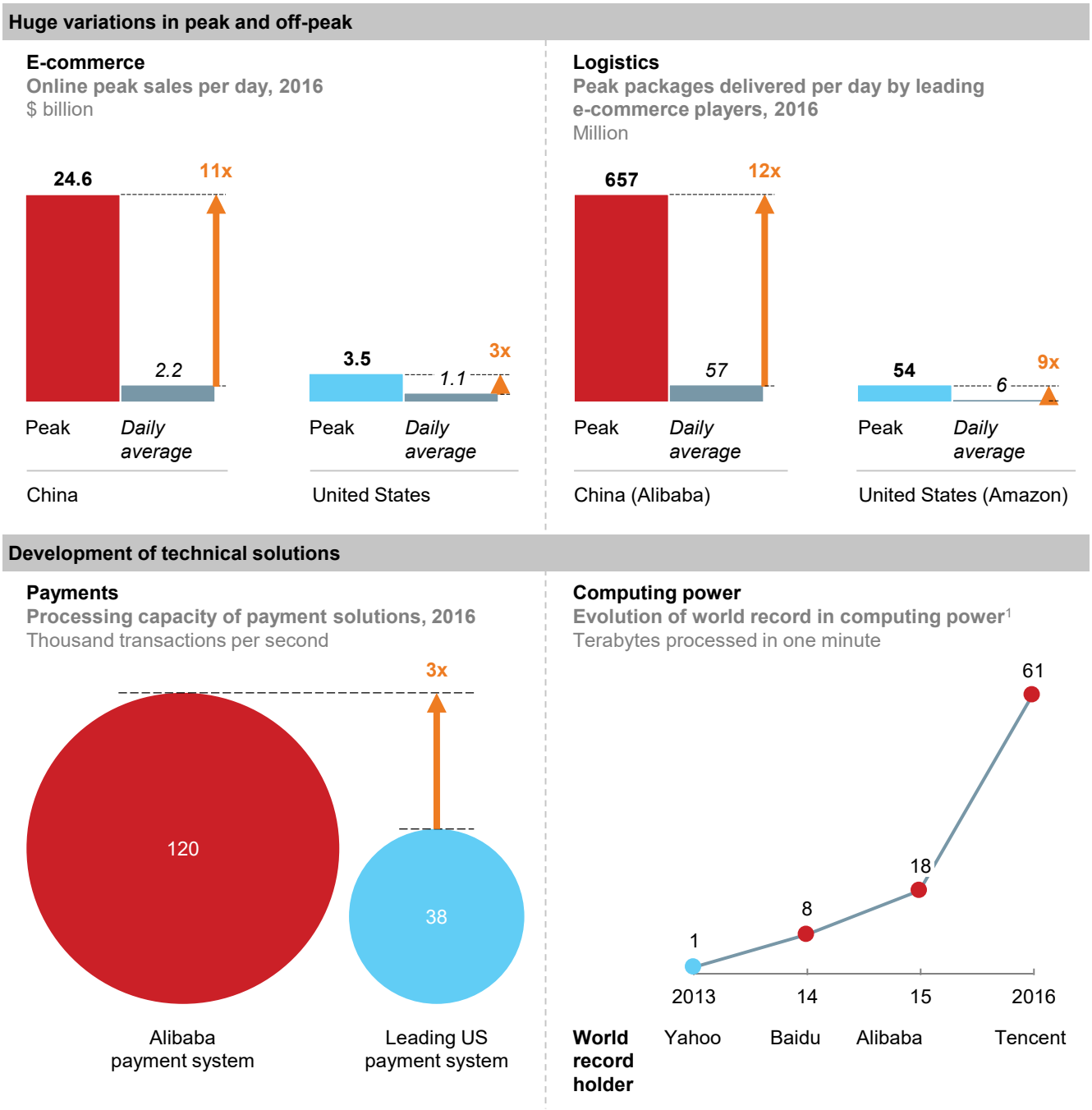
[23] See *Analyzing Ele.me in tier 1 and tier 2 cities*, Sohu, January 24, 2017 (http://www.sohu.com/a/125051753_515896); and *Delivery is bright spot for U.S. foodservice industry*, NPD, April 25, 2017.

landmark online shopping day. In 2016, Alibaba alone racked up $17.8 billion in sales, up from $14.3 billion in 2015.[24] National online sales in just one day were more than Brazil's total projected e-commerce sales for all of 2016.[25] Variability in sales leads to fluctuations in the delivery of products to end-users. Comparing the orders of top e-commerce players in China and the United States, the volume of packages delivered at peak times is around 12 times non-peak volume in China, compared with nine times in the United States (Exhibit 4).

Exhibit 4

Facing huge technical challenges in scale and volatility compared with the United States, Chinese companies have developed greater processing capacities

EXAMPLES



1 According to an assessment of how much data can be processed in a minute in terms of general sorting.

SOURCE: Company official announcements; Profit Confidential; 360doc; Alizala; Sankei; Sort Benchmark; McKinsey Global Institute analysis

[24] Louise Lucas, "Alibaba's Singles Day registers $25bn haul," *Financial Times*, November 11, 2017.

[25] Frank Lavin, "Singles' day sales scorecard: A day in China now bigger than a year in Brazil," *Forbes*, November 15, 2016.

120K
transactions a second processed by Alibaba on Singles Day 2016

Challenges such as huge variations in peak and off-peak volumes of e-commerce transactions have catalyzed the development of new solutions. During Singles Day 2016, Alibaba's payment platform processed 120,000 transactions per second, an estimated three times higher capacity than that of one leading global payments platform.[26] Chinese cloud providers also hold the world record for computing efficiency. In Sort Benchmark's annual global competition—regarded as the "computing Olympics"—Chinese players have rapidly improved their performance in recent years. In the 2013 competition to sort one trillion unordered 100-byte records in ascending order most quickly, Yahoo set a record with 1.4 terabytes per minute. Since then, three successive Chinese players have broken that record: Baidu with 8.4 terabytes a minute in 2014, Alibaba with 18.2 in 2015, and Tencent with 60.7 in 2016.[27] In a 2016 Sort Benchmark competition on cost efficiency, Alibaba's cloud set the record for the lowest cost for sorting 100 terabytes of data at $144. In 2015 and 2014, the record holders were US companies at $155 and $451, respectively. Massive computing capacity and cost competitiveness can create a strong platform for future innovation, especially as AI, with its ability to process data quickly and increase the speed to learning, becomes more mainstream.

Factor 2: Well-capitalized BAT players are building a rich digital ecosystem that is now growing beyond them

Customers' problems are opportunities for innovators. The scale and intensity of customer usage make China a proving ground for cutting-edge capabilities. Baidu, Alibaba, and Tencent have been building strong positions in the digital world by taking out inefficient, fragmented, and low-quality offline markets, while driving technical performance to set new world-class standards. In the process, they have developed powerful new capabilities, and a rich digital ecosystem initially centered on the threesome is now spreading. Unicorns and entrepreneurial startups are proliferating. Traditional companies are expanding their platforms, and China's strength in manufacturing enables unique and rapid combinations of physical and virtual innovation.

Inefficiencies in traditional sectors have created opportunities for BAT and others to innovate

China's labor productivity in many sectors is only 15 to 30 percent of the OECD average.[28] There is no shortage of inefficiencies in China's traditional sectors, which tend to be fragmented and offer low-quality services. But this opens up opportunities for digital attackers to innovate, creating new entrance points to the market and providing fresh value for customers. One area in which new players are active is voice-recognition technology (see Box 1, "Why voice-recognition solutions are becoming popular in China").

In the retail sector, for instance, MGI research in 2013 found that the early impact of e-commerce was more pronounced in China's underdeveloped small and midsize cities even though consumers in these areas had lower incomes than their counterparts in large cities.[29] This reflected the fact that, outside China's major urban conurbations, consumers were not well served by offline traditional retailers; online players made products and brands available to them for the first time.

[26] Steven Millward, "China's Alipay just saw a record 1 billion transactions in a day," Tech in Asia, November 14, 2016.

[27] Sort Benchmark.

[28] *China's choice: Capturing the $5 trillion productivity opportunity*, McKinsey Global Institute, June 2016.

[29] *China's e-tail revolution: Online shopping as a catalyst for growth*, McKinsey Global Institute, March 2013.

Only
25%
of Chinese citizens have a credit score, vs. nearly
90%
in the United States

In the financial sector, in the past depositors had to accept low, and sometimes negative in real terms, interest rates at a time when those rates were regulated. In response to this situation, Alibaba launched Yu'e Bao, which offers interest rates that are two to four percentage points higher. Consumers jumped in, and it took only nine months for Yu'e Bao to become the fourth-largest money market fund in the world. Today, it manages $165 billion and is the world's largest money market fund.[30] Another example is Alibaba's Sesame Credit service, which addresses the fact that only about one-quarter of the Chinese population has a credit score, compared with nearly 90 percent in the United States. This digital-credit-rating service takes advantage of the huge amount of consumer data that now exists online. Alibaba calculates a "social-credit" score based on personal information, ability to pay, credit history, social networks, and behavior. The service covers 381 cities and eight industries. It offers a feature for people with high social-credit scores that covers deposits for hotel bookings and rental of cars and devices; one million deposits have already been waived. Many Chinese regard a high social-credit score as a personal "selling point"—15 percent of users of the online dating site Baihe display their scores on their profiles.

In transportation, commuting in large cities is painful. Only 48 percent of passengers in Shanghai can get a taxi during peak hours, according to one survey.[31] Beijing's traffic jams lead to an estimated $11 billion in lost productivity per year, one study found.[32] Sometimes passengers are forced to take unlicensed private cabs, which have a reputation for not being as safe as licensed vehicles. These challenges for consumers contributed to the rapid rise of the ride-sharing sector and the bicycle-sharing business model. All three BAT internet giants now have a stake in Didi Chuxing, China's largest ride-hailing company, the product of the merger of competitors Didi Dache and Kuaidi Dache, which had been backed by Tencent and Alibaba, respectively.

In health care, Baidu is hoping to use its AI solution Baidu Medical Brain to help address some of the challenges facing the Chinese health-care system, which suffers from structural inefficiencies including a huge urban-rural imbalance of resources, inconsistent quality of treatment, a shortage of doctors and nurses, and lengthy wait times. In addition, in 2016, Baidu launched Melody, an AI-based chatbot designed to help patients and doctors by providing relevant information, including recommendations and treatment options.

30 Louise Lucas, "Chinese money market fund becomes world's biggest," *Financial Times*, April 26, 2017.
31 Liqin Yin, "Shanghai is in the top three most difficult cities for taxi hailing in China," Sina Shanghai, January 21, 2016 (http://sh.sina.com.cn/news/m/2016-01-21/detail-ifxnuvxh5048360.shtml).
32 Men Jing, "Traffic jams cost average Beijinger $1,126 annually," *China Daily*, January 20, 2016.

Box 1. Why voice-recognition solutions are becoming popular in China

Voice-recognition technologies are gaining popularity due to inefficiencies in typing the Chinese language on mobile phones. Typing speed on a smartphone is 1.1 seconds for each word in English but 1.6 seconds for pinyin, the most widely used system of writing Mandarin with the Latin alphabet—a gap of 40 percent. The error rate is 3.7 percent for English but 20.5 percent for Mandarin.[1] This means that consumers have more incentive to use voice recognition when they are reading and writing Mandarin on a mobile phone. Voice recognition more than triples the number of words per minute a user can type into a smartphone and raises accuracy by 16 percent. Chinese digital companies have seized this opportunity to offer competitive services. For example, iFlytek, a Shenzhen-based technology company, launched a popular speech-recognition app for mobile users and has worked with several hardware companies to embed tools such as secure payment, access control, and hands-free voice control into the app.

1 Khari Johnson, "Stop typing on your phone. Using your voice is faster," VentureBeat, September 5, 2016; Sherry Ruan et al., *Speech is 3x faster than typing for English and Mandarin text entry on mobile devices*, Stanford University, August 2016.

The BAT companies are developing a multifaceted, multi-industry digital ecosystem

The BAT companies and others like them began their ascent with an anchor offering—ecommerce in the case of Alibaba, internet search for Baidu, and social media and messaging for Tencent—but have expanded into products and services spanning multiple industries.

Alibaba's core e-commerce business through its online shopping website Taobao was founded in 2003. Alibaba later added the Alipay digital payments business; digital wealth management through companies such as Yu'e Bao; and entertainment through, for instance, the acquisition in 2016 of Youku Tudou, a major video streaming and internet television player.

>900M
active users of WeChat in 2017

Baidu started with its search engine, which today accounts for over 80 percent of market share in China. The company then gradually moved into mobile services on the back of its more than 660 million monthly users of mobile search. In recent years, Baidu has invested billions of dollars into O2O services including food delivery, group buying, and financial products. Now the company is shifting its strategic focus to AI and its commercial application in various sectors. Baidu is opening up its autonomous-vehicle technology to others in an attempt to develop a broader ecosystem. In April 2017 at the Shanghai Auto Show, Baidu unveiled its Apollo project, which it described as an "open, complete and reliable software platform" for its partners in the automotive and autonomous driving industry. [33] Observers see Baidu's move as part of China's broader ambition to become the leading hub for AI.[34] The Apollo project is designed to help partners accelerate bringing autonomous-driving products to market by supplying them with data, APIs, some open-source code, and even reference hardware. Baidu's aim is for the platform to be able to handle full autonomous driving in urban areas by the end of 2020.[35]

One of Tencent's main businesses is social media, including services like WeChat, a messaging app first released in 2011 that had more than 900 million active users by 2017. Social-media services have been a powerful springboard for expansion into other areas such as payments (Tenpay), online banking (WeBank), and on-demand dining services (MeituanDianping).

WeChat's and Alipay's superapps are the natural evolution of this diversification (Exhibit 5). They offer consumers a one-stop shop covering education (such as tuition payments), health (physical activity tracking and medical appointments), information services (news and search), entertainment (gaming and video), e-commerce, and social interactions. WeChat's superapp has expanded to 40 functions, with more lifestyle and finance-related services than previously, while Alipay's has 90 functions, about seven times more than the company offered in 2011.

[33] Charles Clover and Sherry Fei Ju, "Baidu to open-source its autonomous driving technology," *Financial Times*, April 19, 2017.

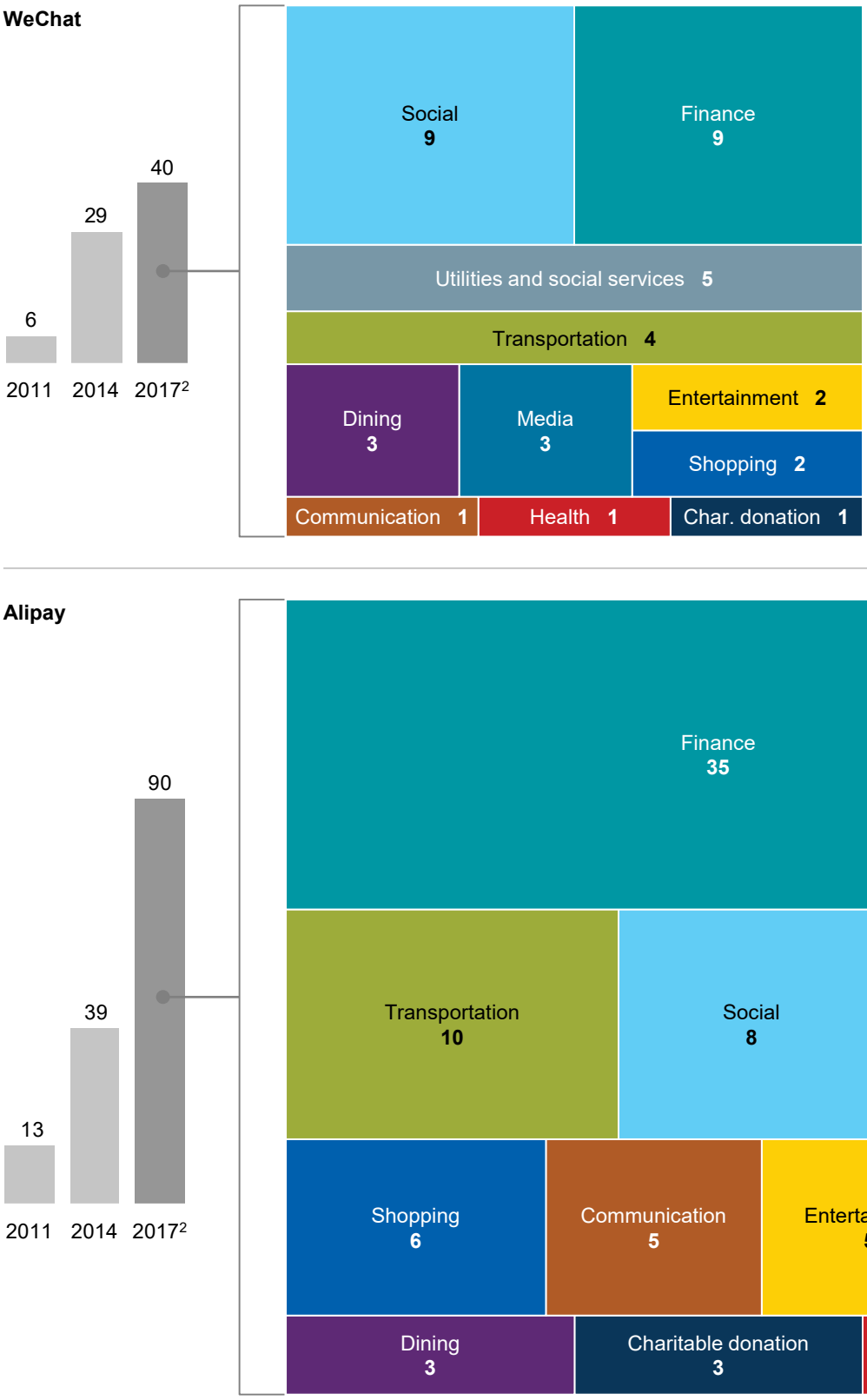
[34] Will Knight, "The self-driving project that could help China leapfrog the West," *MIT Technology Review*, July 5, 2017.

[35] Darrell Etherington, "Baidu's Apollo platform becomes the 'Android of the autonomous driving industry,'" TechCrunch, July 5, 2017.

Exhibit 5

Chinese players have developed superapps that offer a one-stop solution to consumers

Number of features by key application categories[1]



1 Includes newly released app features based on press releases and grouped into 12 key categories: education, entertainment, health, shopping, dining, social, finance, communication, transportation, utilities and social services, media, and charitable donation.
2 As of April 2017.

SOURCE: Company announcements; McKinsey Global Institute analysis

The rise of the superapp gives China's internet giants advantages in the speed of collection of consumer data and its diversity. As the companies have expanded their ecosystems and built up huge user bases, they have been able to significantly accelerate the commercialization and performance of new products and services. For example, it took eight years for Alibaba's Taobao to gain 100 million users, but only five for Alipay to reach the same milestone, and only six months in the case of live broadcasting. Similarly, it took 12 years for Tencent's instant messaging software QQ to gain 100 million users, but only 18 months for WeChat and less than a year for Tenpay. Hongbao—which means "red packets," a nod to the envelopes in which Chinese put cash gifts for friends and relatives during the lunar new year—needed only days to win millions of users for its gift service.[36]

42%
of venture capital in China from Baidu, Alibaba, and Tencent in 2016

These giant internet companies now touch almost every aspect of consumers' lives, and they are in a position to tap into a comprehensive understanding of consumers—a 360-degree view. They can monetize data by offering their customers analytics services. For example, Tencent provides analytics solutions to its corporate customers. When the movie *Kong: Skull Island* was released in China in March 2017, Tencent used its data to send out 46 million advertisements targeted at potential filmgoers. Users were able to download Kong emojis as part of the co-branding and marketing of the movie. Twelve of Tencent's most popular mobile games ran marketing campaigns with ticket giveaways. *Kong: Skull Island* earned $169 million in China, the biggest share of its worldwide box-office take of $565 million, more than receipts in Canada and the United States combined.[37]

China's digital ecosystem is growing beyond the big three

China's digital ecosystem today extends beyond the big three, although BAT has, without a doubt, been a powerful enabler. In 2016, Baidu, Alibaba, and Tencent provided 42 percent of domestic venture capital investment in China. They played a far more prominent role in the development of the digital sector than Facebook, Amazon, Netflix, and Google (often described collectively as FANG), which together contributed only 5 percent of venture capital investment in the United States in that year. One in five top Chinese startups was founded by BAT or BAT alumni, and an additional 30 percent of them receive funding from the BAT firms (Exhibit 6).

Other digital players are building ecosystems, too. For example, Xiaomi has been diversifying around its core product—the smartphone—to embrace aspects of the consumer lifestyle. It has introduced products including "smart" rice cookers, hover boards, robot vacuum cleaners, digital bathroom scales, and electric air purifiers. The company has invested in many hardware startups and allowed them to use Xiaomi brands.[38] It also developed MIUI, a customized operating system based on Android, to power adjacent products on its platform. Its strategy is to maximize the power of its loyal fan base as well as cross-sector synergies.

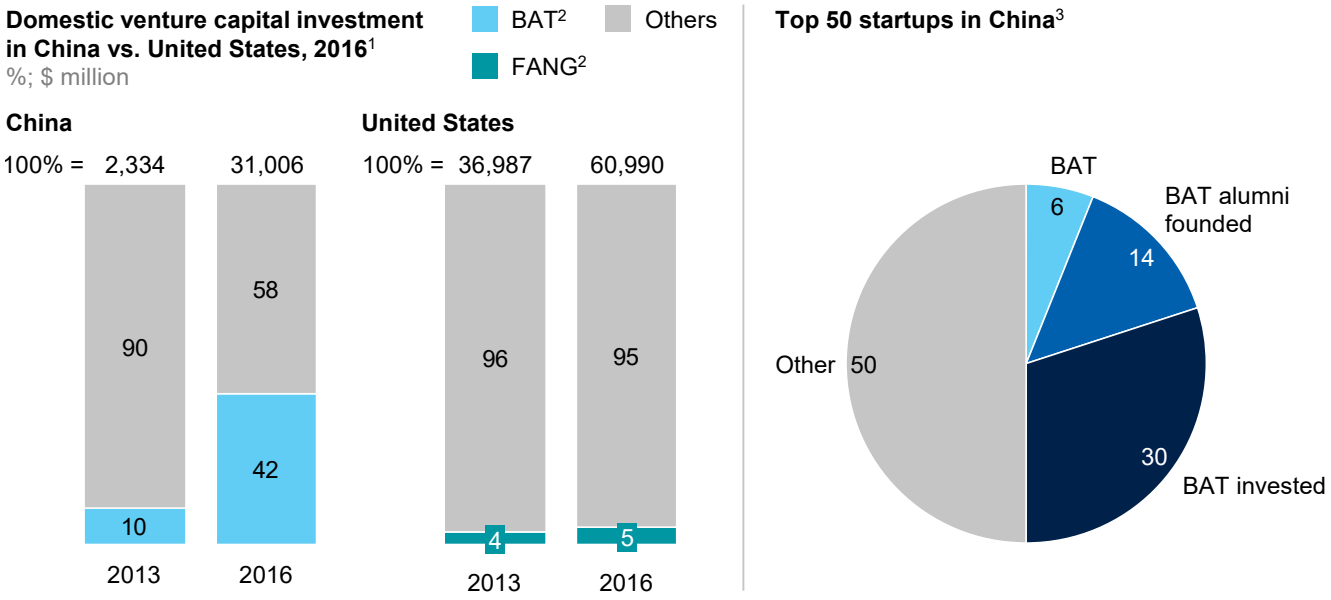
Beyond BAT, NetEase, a leading Chinese internet technology company, has one of the largest mobile news applications and is building its own digital ecosystem. Founded in 1997, the company now has more than ten billion page views per month. NetEase also established a digital ecosystem in both the domestic and international markets that embraces online PC and mobile games, online video entertainment services Bobo and CC, advertising services, email services (with voice search and facial recognition), e-commerce platforms including the cross-border offering Kaola, and online payments and finance through Wangyubao. In July 2017, Disney China and NetEase announced that they were teaming up to create a new cohort of Chinese superheroes to join the Marvel Universe. Twelve Marvel comics,

[36] "WeChat users send 46 billion digital red packets over Lunar New Year—Xinhua," Reuters, February 4, 2017.
[37] Li Yuan, "China's Tencent has an entertainment reach Hollywood would envy," *Wall Street Journal*, June 1, 2017.
[38] "Xiaomi rebounds on ecosystem," *China Daily*, October 24, 2016.

including Spider-Man, Captain America, and Guardians of the Galaxy, are officially available on NetEase's comics platform.[39]

Exhibit 6

China's internet giants are providing funding and talent to the broader digital economy



1 We define domestic venture capital investment as investment from China-based investors in China and US-based investors in the United States.
2 BAT = Baidu, Alibaba, and Tencent. FANG = Facebook, Amazon, Netflix, and Google.
3 According to CrunchBase, which ranks global startups based on number of connections within the platform, community engagement, funding events, news articles, and acquisitions.
NOTE: Numbers may not sum due to rounding.

SOURCE: PitchBook; CrunchBase; McKinsey Global Institute analysis

Traditional companies are also expanding into connected products and services on the back of their core businesses. For example, Ping An, a leading financial services company, has branched out from life insurance into wealth management, car financing and insurance, housing finance, consumer lending, and medical insurance and services. Ping An operates multiple platforms. It has one of China's largest peer-to-peer (P2P) lending platforms, an online real estate platform for crowdfunding, financing, and renting, and an O2O medical services app with which 50,000 doctors collaborate.[40]

Another notable advantage of China's digital ecosystem is its close links to hardware manufacturers. Rapid adoption of digital in China was possible because of low-cost products offered by domestic manufacturers. For example, the penetration of cheap (but superior in some features to more expensive models) smartphones enabled the rapid spread of the mobile internet. Chinese-brand mobiles accounted for less than 5 percent of the total domestic market in 2007; that share has risen to about 90 percent.[41] China is also a leading producer of IoT devices. For instance, China manufactured an estimated 70 to 80 percent of global wearable smartwatches in 2016. China, in particular the Pearl River Delta industrial center, is likely to continue to be a major producer of connected devices because of its strength in manufacturing hardware (see Box 2, "The rise of China's Silicon Delta").

39 Fergus Ryan, "Marvel and NetEase to create new Chinese superheroes for Marvel Universe," China Film Insider, July 7, 2017.
40 He Huifeng, "Medical services app Ping An Good Doctor raises US$500m," *South China Morning Post*, May 20, 2016.
41 "Over 500 million volume of shipping for Chinese mobile phones, accounting for 90% in 2016," China Institute of Telecommunications, January 11, 2017 (http://www.199it.com/archives/556239.html).

Box 2. The rise of China's Silicon Delta

Shenzhen, in the Pearl River Delta industrial center, used to be known as the world center for *shanzhai*, or copycat products—for example, devices that looked identical to iPhones or Samsung Galaxy S, available before the official products even came to market. But times have changed. Shenzhen is now known as China's open innovation center, and digitally connected networks have been the key enabler. Here we highlight just three examples of how innovators in the city are using digital.

DJI. The Shenzhen-based drone manufacturer commands more than 70 percent of the global consumer drone market; more than 80 percent of revenue comes from outside China. About half of the company's 3,000 workers are engaged in research and development (R&D). CEO Frank Wang spends a significant portion of his time with the R&D team. Digital communication plays an important role in exchanging ideas and cutting through organizational hierarchies. The working teams can use WeChat to debate ideas and get rapid feedback from the CEO, helping to accelerate the speed of innovation.

HAX. The hardware-focused incubator brings entrepreneurs from around the world to the city for rapid prototyping and commercialization. Like many electronics suppliers, HAX is based in the Huaqiangbei district of one of the largest electronics markets in the world. To help entrepreneurs from abroad easily connect with local experts, suppliers, and partners and tap into Shenzhen's digital ecosystem, the company encourages them to use WeChat.[1]

Shenzhen Capital Group (SCGC). Founded by the Shenzhen municipal government in 1999, SCGC is now China's leading domestic venture capital firm, managing more than 200 billion renminbi ($29 billion). In 2016, the company reported a net profit of 1.3 billion renminbi ($191 million), representing an annual return on investment of 36 percent.[2] In the 600-plus enterprises it helps to finance, investment in internet companies has become an increasing focus.[3] SCGC's digital investments cover a wide range of sectors, from consumer goods to infrastructure, and include manufacturers of VR entertainment equipment, robotics startups, and smart city infrastructure providers.

1 Li Yuan, "Behind the great firewall, the Chinese internet is booming," *Wall Street Journal*, June 8, 2017.

2 Fangyuan Gao, "Ten pioneer PE market makers show a 'butterfly effect' tendency," Xinhua, December 16, 2016 (http://news.xinhuanet.com/fortune/2016-12/16/c_1120127617.htm); Cui Yan, "Shenzhen Capital Group's net profit achieved 30% year-on-year growth in 2016," Sina, June 2, 2017 (http://finance.sina.com.cn/roll/2017-06-02/doc-ifyfuvpm7200922.shtml).

3 Zilin Wang, "Analysys received 90 million in series B financing, SCGC as the lead investor," China Securities Network, October 27, 2016 (http://news.cnstock.com/news,bwkx-201610-3933931.htm).

Factor 3: The government gave digital players space to experiment before enacting official regulation and is now becoming an active supporter

The Chinese government has mixed inaction and action in its approach to digitization. It moved to regulate the burgeoning digital sector only after a delay, an approach that gave innovators plenty of space to experiment. But today, the government is playing an active role in building world-class infrastructure to support digitization as an investor, developer, and consumer.

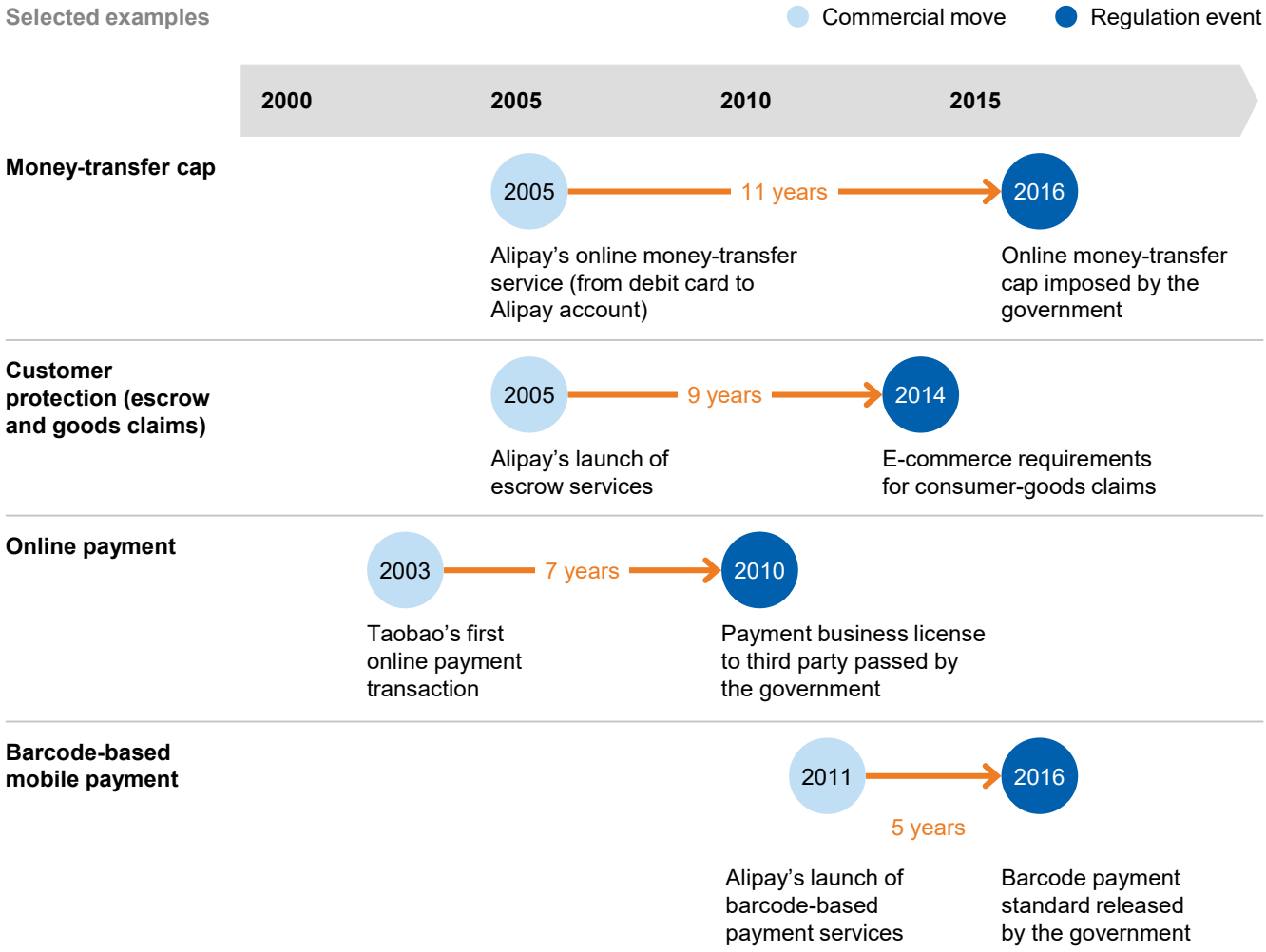
Inaction: The government gave players a free hand to experiment

Light-touch—or, more accurately, late—regulation of digital activities and players in China has encouraged entrepreneurship and experimentation (Exhibit 7). While the response of regulators lagged behind market developments, China's internet giants were relatively free to test and commercialize products and services and to gain critical mass. For example, regulators took 11 years after Alipay introduced online money transfers in 2005 to set a cap on the value of the transfers. It was five years after Alipay introduced barcode-based payment solutions that Chinese regulators produced an official standard on management requirements.

Exhibit 7

In mobile payments, government policy left space for innovators to experiment

Selected examples



Online payment transactions $ billion	<1	2	149	1,811

SOURCE: Official regulatory announcements; SAIC and Ministry of Commerce; Alibaba, Baidu, and Tencent annual reports; McKinsey Global Institute analysis

The rapid penetration of digital devices partly reflected weak enforcement of intellectual property rights in the early stages of the development of the internet in China. In the first wave of digitization, consumers had relatively easy access to digital content, including music, books, and movies. The fact that consumers were able to access free content helped penetration of digital devices to deepen and broaden. We do note, however, that the light-touch approach to regulation led to copying and patent infringement that has the potential to reduce perceived incentives for real innovation in the economy. In 2008, the International Federation of the Phonographic Industry consortium of leading content companies said that more than 99 percent of music downloads in China were illegal, and the organization sued some search sites.[42] A 2010 survey found that piracy had resulted in a 100 billion renminbi ($15 billion) loss in the software sector, and a 28 percent loss in sales.[43] As the market has matured, both the government and the private sector have gradually

[42] Mure Dickie, "Music companies launch new Baidu lawsuit," *Financial Times*, February 5, 2008.

[43] *China lost over 100 billion RMB in software sales because of privacy last year*, China Labs and CyTeam, May 13, 2011 (http://ip.people.com.cn/GB/14624176.html).

become more proactive about shaping healthier digital development through regulation and enforcement. For instance, in 2014, China began opening specialized intellectual property courts in Beijing, Guangzhou, and Shanghai. As leading Chinese companies grow and many are newly listed on domestic and overseas stock markets, they have stepped up efforts to comply with intellectual property rules.

While the regulatory vacuum encouraged exponential growth among digital players, it also sometimes led to supervision and consumer protection issues. For example, the number of P2P lending platforms in China soared to 3,500, but then fell by about one-third from the peak. During the initial hype and subsequent adjustment, consumers suffered some collateral damage. In 2015, Ezubao, one of the largest and best-known P2P lenders, was exposed as a Ponzi scheme in which 900,000 users lost 50 billion renminbi ($7.5 billion).[44] According to a recent report, nine out of every ten P2P lenders may struggle to survive as the government tightens regulation.[45] In China's more developed digital environment, the government has unveiled new regulations. The first cybersecurity law, which became effective in June 2017, includes protection of personal information, security requirements for network operators, and restrictions on personal and business data transfer.

Action: The government has been not only a policy maker but also an investor, innovator, and consumer in an effort to support digitization

China's government aims for AI application market of

>100B

renminbi

($15B)

The Chinese government has advanced a number of policies designed to strengthen the digital economy as a new engine for economic growth. In 2015, the government unveiled the concept of "Internet Plus" and followed up with a detailed action plan to integrate the internet, cloud computing, big data, and IoT with traditional manufacturing and consumer industries.[46] Over the past two years, the government has led implementation of Internet Plus in a range of sectors including logistics, social security, and manufacturing.

In June 2017, Shanghai launched the first internet shipping port, which integrates e-commerce companies in shipping logistics, data analytics, related financial and legal services, and office space in one place.[47] Zhejiang Province is running pilot programs to explore the development of online applications for social security cards that will enable citizens to pay for health insurance via the internet and mobile phones. The idea is to integrate a range of services, including applications for official identification and the filing of government documents, into one portal that has social media applications such as WeChat.[48] Shenzhen has employed Internet Plus in government services since 2014, saving citizens a great deal of time on the filing of property, work, and school-entrance certificates.[49]

The government has also actively facilitated investment in digital. In 2016, the National Development and Reform Commission of China, the government's economic planning agency, announced its "Three Year Action Plan of Internet Plus Artificial Intelligence" that aims to build an AI application market valued at more than 100 billion renminbi ($15 billion) by developing nine major AI ecosystems, including smart home appliances, intelligent cars, wearable devices, and smart terminals. The plan stipulates that various government

44 "Ponzis to punters: Financial scams may pose as big a political problem for Xi Jinping as the stockmarket crash," *The Economist*, February 6, 2016.

45 Daniel Ren, "China regulators warn that 90 pc of peer-to-peer lenders could fail in 2017," *South China Morning Post*, February 19, 2017.

46 "China unveils Internet Plus action plan to fuel growth," The State Council of the People's Republic of China, press release, July 4, 2015.

47 Zhiyan Wang, "China launched its first 'internet plus' shipping industry base in Lujiazui, Shanghai," *Shanghai Observer*, June 23, 2017 (http://sh.eastday.com/m/20170623/u1ai10669236.html).

48 *"Once at most": Zhejiang Province to increase efficiency through "internet plus" social security services in collaboration with the Ministry of Human Resources and Social Security*, Zhejiang Government, June 23, 2017 (http://zjzwfw.gov.cn/art/2017/6/23/art_1177809_7819592.html).

49 Zhangwen Lian, "Shenzhen shares its experiences in 'internet plus' government services," Xinhua, April 29, 2017 (http://news.xinhuanet.com/info/2016-04/29/c_135323019.htm).

institutions can provide funding for specific projects from budgets controlled by central and regional governments. In March 2017, the agency authorized Baidu to lead the first national engineering lab focusing on deep learning in collaboration with institutions including Tsinghua University, the China Academy of Information and Communications Technology, and the Beijing Electronics Standardization Institute.

$180B
investment in 5G over seven years expected from Chinese state-owned enterprises

In addition, the government provides funds to new internet businesses. Since 2014, the state has encouraged citizens to participate in mass entrepreneurship and innovation using measures such as tax deductions and state-endorsed startup funds. At least 2,500 tech incubators in China have passed the government's registration requirement.[50] Many municipal governments have set up incubators and offered generous funding. In August 2016, the government approved the establishment of a state-owned $30 billion venture capital fund in Shenzhen, home to many digital startups.[51] Beijing Zhongguancun Inno Way, a high-tech community known as China's Silicon Valley, launched its first 500 million renminbi ($75.3 million) venture capital fund targeting AI-related startups. Zhongguancun alone has incubated 1,900 startups in the past three years.[52] The government has also shown itself willing to pilot the commercialization of new technologies through state-owned enterprises (SOEs) including China Mobile, China Unicom, and China Telecom. The plan is for these companies to spend up to $180 billion over seven years on building the infrastructure for what is envisioned as the world's largest 5G mobile network.[53]

The Chinese government itself has been an ambitious innovator of high-tech R&D. Its successful launch of Micius, the world's first high-security quantum satellite, signaled its ability to lead in innovation and experimentation.[54] The satellite is China's first successful venture in quantum technology. If the technology is fully commercialized, China could potentially offer the world's safest and fastest internet.[55]

The government has also acted as a consumer of new digital technologies. China's high-speed rail project is an example of the government playing a central role in creating a new market, facilitating the transfer of technology, and encouraging innovation.[56] Local leaders are already adopting the latest technologies to improve the management of urban areas. For example, facial-integration technology using AI is being deployed to influence citizens' behavior. In some districts of Shenzhen, for instance, photographic images of jaywalkers are taken and then displayed on video screens installed above streets.[57] Anhui Province worked with an AI company to identify phone scammers by analyzing voiceprints created using biometric and behavioral characteristics.[58] Growing markets can help to enable the commercialization of such technologies, although there may be some social discomfort about the use of such solutions by policy makers to scrutinize citizens' behavior.

50 "Top 50 innovation and startup incubator report: China has the most incubators in the world," Sohu, September 18, 2016 (http://www.sohu.com/a/114536039_379992).

51 C. Custer, "Report: China's government establishes $30 billion VC fund," Tech in Asia, August 17, 2016.

52 Xiaoyu Li, "Innoway launches its first 500 million RMB startup VC, with focus on AI," Xinhua, June 6, 2017 (http://news.xinhuanet.com/fortune/2017-06/06/c_129626451.htm).

53 Bien Perez, "China set to build the planet's largest 5G mobile network for US$180b," *South China Morning Post*, June 12, 2017.

54 Stephen Cheng, "China's hack-proof quantum satellite leap into space leads the world," *South China Morning Post*, August 16, 2016.

55 Qinxiu Chen, "Quantum technology will bring infinite possibilities," *Economic Daily*, February 2, 2017 (http://news.xinhuanet.com/info/2017-02/11/c_136048777.htm); "China launches quantum-enabled satellite Micius," BBC, August 16, 2016.

56 *The China effect on global innovation*, McKinsey Global Institute, October 2015.

57 Josh Chin and Liza Lin, "China's all-seeing surveillance state is reading its citizens' faces," *Wall Street Journal*, June 26, 2017.

58 "Minitrue: 'Voiceprint analysis can recognize swindlers,'" *China Digital Times*, February 28, 2017.

$38B
Chinese outbound venture capital in 2014–16

CHINA'S DIGITAL GLOBALIZATION IS JUST GETTING STARTED—AND IS LIKELY TO HAVE A MAJOR IMPACT ON THE WORLD ECONOMY

In combination, the three factors propelling the expansion of digital China mean that China has an increasingly visible presence on the global stage and rising impact on the world economy. Over recent decades, the Chinese economy has become closely integrated into the global economy through value chains, but the future is expected to be about digital globalization rather than physical trade.[59] A rising number of Chinese digital companies are developing a global presence through M&A, by expanding their business models, and as providers of technology to partner companies. These developments could mean that China sets the world's digital frontier in coming years. China's increasing prominence on the world's digital stage also means that the country can contribute, and even lead, broader debates on global governance issues such as barriers to foreign competition, reciprocity, and digital sovereignty.

- **China is already a major player in global data flows.** China's digital ecosystem is already having a marked influence on global cross-border flows of goods, services, finance, and data. Its exports and imports of digital goods and services have facilitated those flows. Although China has been running a trade deficit in services—of $172 billion in 2014 and $182 billion in 2015—it has been a net exporter of digital services, with an annual surplus of $10 billion to $15 billion over the past five years. Although China is widely criticized for constructing a "Great Firewall" to control the flow of information, it is already in the worldwide top six for flows of data in terms of bandwidth.[60] As recently as 2005, it ranked 13th in data flows.

- **China is becoming a major worldwide investor in digital.** China-based venture capital companies are increasingly active overseas investors. China's outbound venture capital totaled $38 billion in 2014–16, reaching 14 percent of global venture capital investment outside China.[61] Between 2011 and 2013, that share was only 4 percent and just $6 billion. About 80 percent of investment went to advanced economies, and approximately 75 percent was invested in digital-related sectors. Clearly, China's influence in the global startup market is growing rapidly as it drives to acquire technology, talent, and products and services.

- **Chinese digital companies are active in driving global M&A activities.** Over the past two years, China's top three internet companies made 35 overseas deals, compared with 20 by the top three US internet companies. Tencent struck a high-profile deal to take a majority stake in Supercell, the developer of the popular Clash of the Titans computer game; the deal valued Supercell at $8.6 billion. Tencent now generates more than 10 percent of global gaming revenue, making it the largest gaming company in the world.[62] In 2016, Alibaba invested $1 billion to acquire a controlling interest in leading e-commerce platform Lazada, which has 550 million customers in six Southeast Asian countries. Traditional companies are also expanding rapidly and developing

[59] China's share of global manufacturing value added increased from less than 7 percent in 2000 to nearly 28 percent in 2016. Since 2013, China has been the world's largest trading nation for goods, overtaking the United States, which had been the largest since World War II. MGI has conducted extensive research on global flows, including digital flows. See *Digital globalization: The new era of global flows*, McKinsey Global Institute, March 2016; *Global flows in a digital age: How trade, finance, people, and data connect the world economy*, McKinsey Global Institute, April 2014; and *China's role in the next phase of globalization*, McKinsey Global Institute discussion paper, April 2017.

[60] Defined as the sum of all bandwidths (gigabits per second) of a certain country, compared with the rest of the world. The top five countries, in order, are the United States, Germany, the United Kingdom, France, and the Netherlands.

[61] Calculated as outbound venture capital investment by China-based companies divided by total global venture capital investment by companies based outside China into all countries except China. All figures are based on the values of deals that have closed.

[62] "Supercell acquisition: Tencent set to take 13% of this year's $99.6bn global games market," Newzoo, June 21, 2016.

an international presence in digital technologies. For instance, telecommunications equipment and services company Huawei spent $192 million in December 2016 alone on the acquisition of two Israeli startups focused on the cybersecurity of database technology and on software-based system and chip-design technology.

- **China is exporting digitally driven business models.** Chinese digital companies are also expanding business models outside the country's borders. Ofo and Mobike, China's "dockless" bicycle-sharing companies, have moved into Singapore, the United Kingdom, and the United States. The GPS-connected bicycles can be located and unlocked using an app.[63] Musical.ly, a lip-syncing and video-sharing app, is arguably the first social media app from China that has gained widespread popularity in the United States and other parts of the world. Initially launched in both Chinese and English, Musical.ly shifted focus to the United States and other markets as demand in the United States took off. The app now has more than 100 million users around the world.[64] Meitu, a selfie app with image-editing software that enables users to beautify self-portraits, has become very popular with young customers. The company has expanded aggressively, setting up offices in Brazil, India, Japan, the United Kingdom, and the United States, among other countries.

- **China's digital players are enabling digitization globally.** China's digital technology is also enabling foreign partners. For instance, in 2017, news aggregation app company Jinri Toutiao ("today's headlines") invested $19 million in one of India's largest local-language content aggregation and recommendation service providers, Dailyhunt. The CEO of Dailyhunt said that the company intended to use Jinri Toutiao's technology and expertise to execute large-scale personalization through machine learning.[65] KT Corporation, South Korea's largest telephone company, cofounded K-Bank, the country's first internet bank, and Alibaba affiliate Ant Financial became a shareholder. Ant Financial also provides technical solutions such as fraud detection systems—a critical part of running an internet-based bank.[66] Nvidia, a California-based mobile and computer processing company that designs graphics processing units for the gaming and professional markets, as well as chip units for the mobile computing and automotive markets, formed a partnership with Baidu to use AI for a cloud-to-car autonomous-car platform. Hyundai was the first global car manufacturer to deploy Baidu's AI assistant, Duer OS Auto, and jointly develop a connected-car solution.[67]

•••

China has become a force to be reckoned with in digital at home and around the world, especially in consumer-related areas. As a major worldwide investor in digital technologies and one of the world's leading adopters of such technologies, it is already shaping the global digital landscape and supporting and inspiring entrepreneurship far beyond its own borders. But how much more is to come? In the next chapter, we introduce the MGI Industry Digitization Index for China, which shows the relative position on digitization of Chinese sectors and therefore gives an indication of further scope for digitization.

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63 Benjamin Haas, "'Uber for bikes': Chinese firms eyes global dominion with launch in Manchester," *The Guardian*, June 12, 2017.

64 Sherisse Pham, "How a Chinese social media app made it big in U.S.," CNN Tech, November 27, 2016.

65 Shashti Shankar, "Franklin PE arm exits Dailyhunt, clocking over 3-fold return," *Economic Times* (India), February 1, 2017; Malavika Yalayanikal, "China's ByteDance leads $25m funding for Indian local language news app Dailyhunt," Tech in Asia, October 15, 2016.

66 Lee Min-hyung, "KT, Kakao set to lead online bank with on-demand service," *The Korea Times*, November 30, 2015.

67 Jhoo Dong-chan, "Hyundai joins hands with Baidu," *The Korea Times*, July 3, 2017.

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2. HOW DIGITIZED ARE CHINA'S SECTORS?

Digital technologies are being widely adopted by consumers and rapidly commercialized in China. The next wave of digital transformation in China is likely to come from broader adoption of these technologies by businesses in different sectors.[68] The digitization of industries has the power to restructure value chains, enable creative destruction, and eventually lead to higher productivity (see Box 3, "Digitization can improve the productivity of sectors and the economy").

In this chapter, we introduce the McKinsey Global Institute Industry Digitization Index for China, which assesses where the country's sectors stand on digitization and compares them with their counterparts in other advanced economies. We find that Chinese industries are at very different stages of digitization, and that overall there is a substantial gap between sectors in China and the United States. However, we also find that this gap is closing, and that as more industries digitize, Chinese businesses have significant opportunities to boost their productivity.

CHINESE INDUSTRIES LAG BEHIND THEIR COUNTERPARTS IN ADVANCED ECONOMIES ON DIGITIZATION, BUT ARE RAPIDLY CLOSING THE GAP

Top three Chinese sectors

6.5x

more digitized than the bottom three

To quantify the degree to which different Chinese sectors have digitized, we used the same methodology as in MGI's previous research on digitization in the United States and Europe.[69] We analyzed 22 industries on 25 indicators and used this analysis to calculate the index on three dimensions: assets, their use, and labor. In order to compare the degree of digitization in similar sectors in China, the United States, and the EU, we used common indicators for the three and then broadly quantified the gap. We acknowledge that each country is different and may well have a different optimal degree of digitization. Nevertheless, this analysis helps us to understand variations in digitization among sectors, the rough sizes of gaps among them—and between sectors in China and their counterparts in the United States and the EU—and therefore the upside potential from further digitization.

Some findings on the relative digitization of sectors within China are consistent with the patterns that MGI observed among sectors in the United States and the EU (Exhibit 9). In all three geographies, the ICT, media, and finance sectors tend to be the most digitized, and fragmented local sectors such as agriculture, local services, and construction tend to be the least digitized. In all three, there are large gaps in scores on MGI's digitization index between the top three sectors and the bottom three. On average, the top three are 5.8 times more digitized than the bottom three in the United States, 6.1 times in the EU, and 6.5 times in China. This suggests ample room for further digitization in all.[70]

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[68] *China's digital transformation: The internet's impact on productivity and growth*, McKinsey Global Institute, July 2014.

[69] *Digital America: A tale of the haves and have-mores*, McKinsey Global Institute, December 2015; *Digital Europe: Pushing the frontier, capturing the benefits*, McKinsey Global Institute, June 2016.

[70] We note that there are limitations to our ability to make effective cross-sector comparisons. The degree of digitization can vary from sector to sector because of differences in the nature of sectors. For instance, a sector with high capital intensity will, by definition, have a low share of spending on digital technologies as a percentage of total spending. Nevertheless, we believe that MGI's Industry Digitization Index offers useful quantitative guidance on the degree of digitization in different sectors and, at the very least, provides a directional foundation for comparison.

Box 3. Digitization can improve the productivity of sectors and the economy

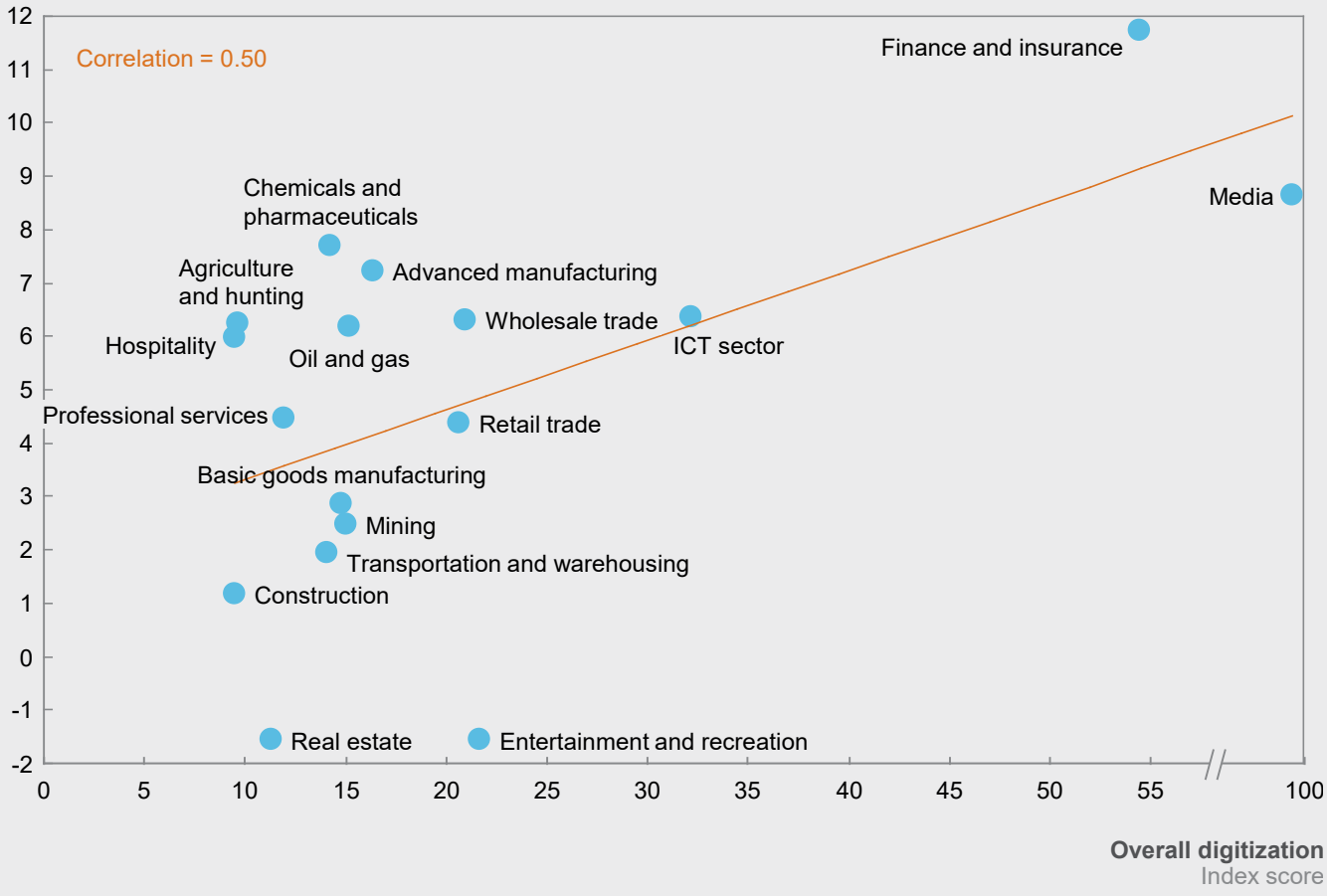
MGI's research on digitization in the United States and Europe has found that firms in the most digitized sectors tend to be more profitable. In the United States, average profit margins in the most digitized sectors grew two to three times as much as those of less digitized sectors over the past 20 years. Even within highly digitized sectors, the margin spread between the top-performing and lowest-performing companies is two to four times as large as in non-digitized sectors—a clear sign that winner-takes-all dynamics are at work.

MGI's Industry Digitization Index for China reveals a similar overall picture as in the United States and the EU. Sectors that have a high degree of digitization tend to post faster growth in labor productivity than those that are less digitized (Exhibit 8). The productivity gains come from two sources. The first is the restructuring of value chains due to digitally enabled attackers taking advantage of inefficiencies to offer cheaper and more attractive solutions to customers. The second is the use of companies' operations to increase revenue and reduce costs (see Chapter 3 for a detailed discussion).

Exhibit 8

Productivity growth in China's sectors is positively correlated to overall digitization

Correlation between overall digitization and productivity growth[1]



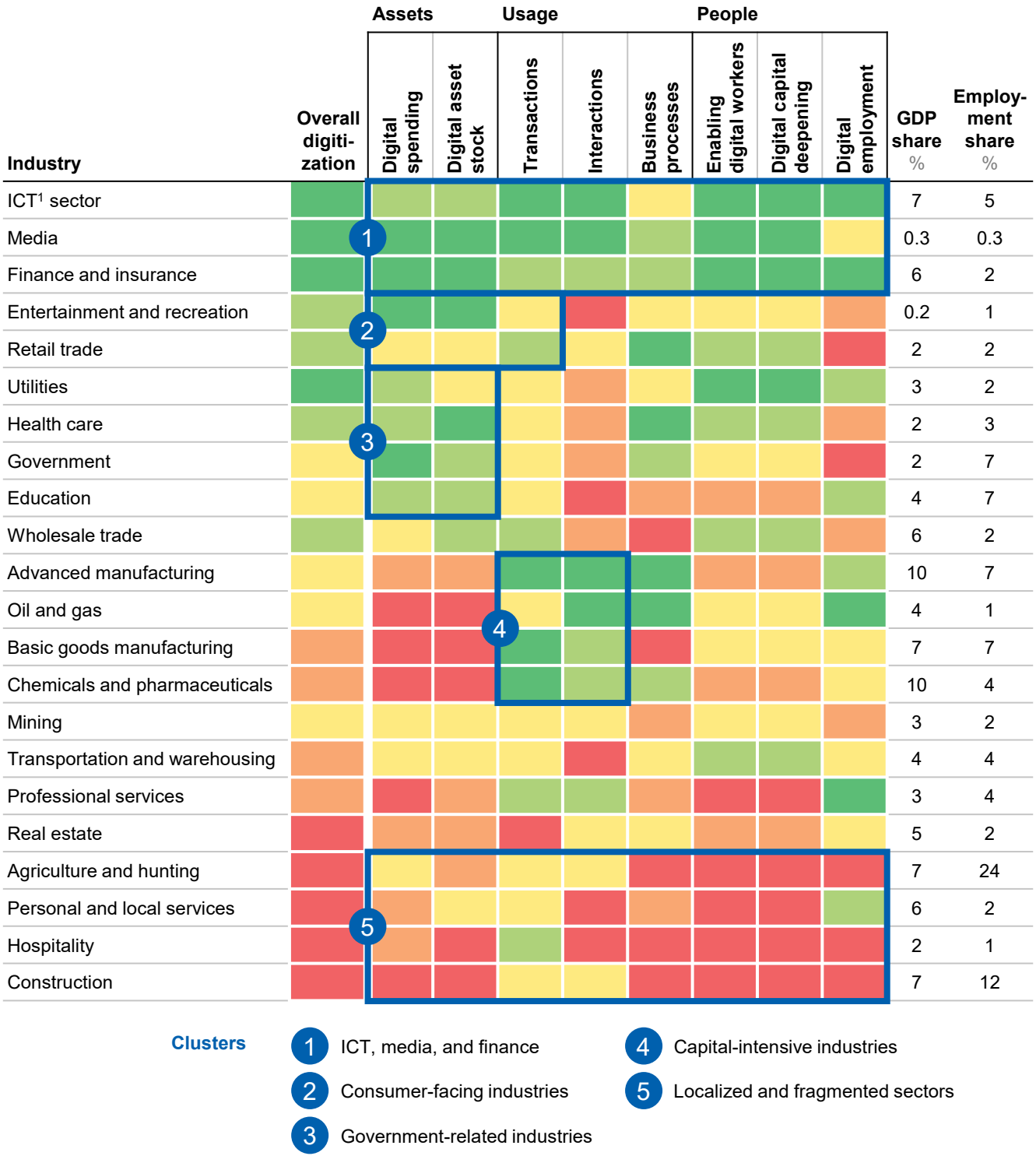
1 Excluding public and semi-public sectors (e.g., education, government, health care, utilities, and personal and local services).

SOURCE: IHS Global Insight; National Bureau of Statistics; McKinsey Global Institute analysis

Exhibit 9

MGI Industry Digitization Index: China

Less digitized — More digitized



1 Information and communications technology.

SOURCE: Gartner; Kable; OECD; Central Bureau of Statistics; Bloomberg; McKinsey Global Institute analysis

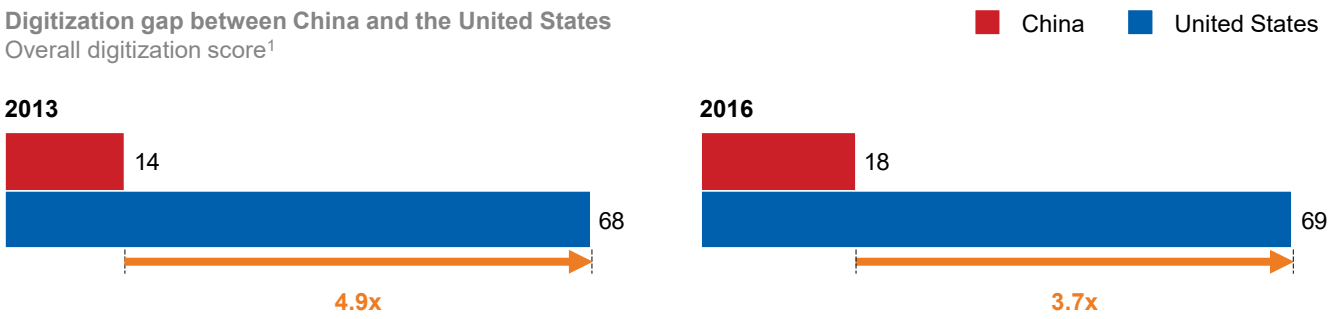
However, the relative positions of some key sectors in China are somewhat different from those elsewhere. For instance, government-related sectors and consumer-focused industries (retail and entertainment) in China rank higher on digitization relative to other sectors than they do in either the United States or Europe. In China, government ranks eighth out of 22 sectors, whereas in the United States it ranks 18th and in the EU 16th. In the case of retail trade, in China the sector ranks fifth; in the United States and the EU, it ranks 15th and 14th, respectively. In China, entertainment and recreation ranks fourth, compared with 16th and 19th in the United States and the EU, respectively.

Our analysis shows that although China lags behind the United States and the EU in overall digitization, the gap is closing rapidly. In 2013, the United States was 4.9 times more digitized than China; in 2016, that figure had fallen to 3.7 times (Exhibit 10).

One factor behind this narrowing gap is action by China's government, as we noted in Chapter 1. The government has announced a series of policies that have increased awareness about the benefits of digital solutions and have promoted investment. In 2015, the State Council announced Internet Plus to promote broad digitization of industries as well as Made in China 2025, which includes smart manufacturing. In Guangdong Province, for example, the government has set an ambitious target of 80 percent automation by 2020.[71] In addition, as noted in Chapter 1, Chinese consumers are rapidly adopting digital solutions, leading to companies increasing their investment in digitization in order to meet demand. Another important factor behind the narrowing gap is the fact that Chinese corporate leaders are pursuing digitization aggressively. According to a 2016 survey of chief innovation officers, the executives in China were more aggressive on investment in IT infrastructure than their global peers. IT budgets in China were set to increase by 12 percent on average in 2016, compared with just 2 percent expected by chief innovation officers globally. [72]

Exhibit 10

China is narrowing the gap with the United States on digitization



1 Calculated and scaled based on 12 common metrics from the MGI Industry Digitization Index.

SOURCE: McKinsey Global Institute analysis

[71] "Robot revolution sweeps across China," *China News*, September 28, 2015 (http://www.chinanews.com/cj/2015/09-28/7547814.shtml).

[72] *2016 CIO agenda: A China perspective*, Gartner, February 2016.

MGI'S INDUSTRY DIGITIZATION INDEX FOR CHINA REVEALS FIVE CLUSTERS OF SECTORS THAT ARE AT DIFFERENT STAGES OF DIGITIZATION

Our analysis reveals that China has five clusters of sectors that are at different stages of digitization.

Cluster 1. ICT, media, and finance are the most digitized sectors in China, as they are in other countries

ICT, media, and finance are the top three industries for digitization and are digitized on all three dimensions captured in MGI's index. This is consistent with MGI's findings for the United States and the EU (see Box 4, "China's supply of ICT is gradually improving, establishing the foundation for broader digitization of its economy").

- **ICT.** The ICT sector comprises a wide range of products and services, such as telecommunications, internet, IT services, and hardware and software. Chinese companies have been investing substantial amounts in digital assets. For example, internet companies have spent heavily on IT infrastructure to meet expanded demand for data and computing demand as they scale up. To give an idea of the size of this investment, demand for servers by China's internet giants is as large as total national demand in economies such as Brazil and South Korea.[73] As internet companies expand into different sectors, they become key enablers in those sectors by offering their digital platforms for retail, entertainment, transportation, and hospitality, for example. China's semiconductor industry has also been investing heavily in automation and digitization. The industry uses a high degree of automation and digital tools in manufacturing and process management, reflecting the fact that it is a global industry. Products are rarely customized for specific regions—there are no Taiwanese packages, South Korean memory chips, or Japanese industrial semiconductors. Global players tend to build state-of-the art facilities in China to meet domestic and international demand, and they have partnered with local players in China. Qualcomm has partnered with SMIC on 28-nanometer products and the development of 14-nanometer process technology. UMC is collaborating with the government of Xiamen and FuJian Electronics and Information Group on a $6.2 billion investment in a foundry. Intel has invested $1.5 billion in a subsidiary of Tsinghua Unigroup, which owns RDA and Spreadtrum, two of the largest fabless-design companies.[74] Although Chinese semiconductor players have technology gaps compared with global leaders, they have been investing heavily to serve global customers. SMIC, a leading Chinese foundry company, generates about half its revenue from overseas.[75] In the telecommunications industry, companies have been investing heavily in infrastructure in order to serve 1.3 billion mobile subscribers. China Mobile alone spent an estimated 450 billion renminbi ($68 billion) on its 4G network.[76]

[73] *Decoding the server purchase volume of BAT*, Hexun Technology, March 7, 2016 (http://tech.hexun.com/2016-03-07/182598675.html).

[74] Christopher Thomas, *A new world under construction: China and semiconductors*, McKinsey & Company, November 2015.

[75] Louise Lucas, "US concerns grow over Chinese chip expansion," *Financial Times*, January 16, 2017.

[76] "China has more than 1.3 billion mobile phone users," Sina, October 19, 2017 (http://tech.sina.com.cn/t/2017-10-19/doc-ifymvuyt4566861.shtml); and Bing Shang, *China mobile has invested 450 billion renminbi on 4G network until now*, Sina Tech, June 28, 2017 (http://tech.sina.com.cn/roll/2017-06-28/doc-ifyhmtrw4297351.shtml).

Box 4. China's supply of ICT is gradually improving, establishing the foundation for broader digitization of its economy

In our analysis of the digitization of different geographies, we found relatively large gaps between certain sectors in China and the United States on the basis of industry averages. One sector where China lags behind is ICT. This partly reflects a huge variation among companies operating in China's ICT sector. Some participants are highly digitized global technology companies, but there is also a long tail of less digitized, often smaller players. We looked at the investment in ICT and the IT budget per full-time employee for the top 50 ICT companies in China and found that the top five companies account for about 60 percent of total IT investment, and that the IT budget per full-time employee for the top five companies is four times as high as for the companies ranked 26th to 30th (Exhibit 11).

However, signs of progress are evident. For instance, Chinese players account for the majority of the country's "infrastructure as a service" public cloud market. The value of that market reached $1.4 billion in 2016 from $452 million in 2014, representing annual growth of 77 percent, according to the International Data Corporation. Four of the top five companies are Chinese, and they account for more than half of the total market. The success of Chinese companies partly reflects regulation that requires foreign companies to establish joint ventures if they are to have a presence in the Chinese market. However, as Chinese players use their home-market advantage and develop cost-effective solutions, they may, in turn, catalyze success among a larger number of local players. China has been improving its computing power, too. In June 2017, China was second in the world with 160 supercomputers. The United States had 168, Japan 33, Germany 28, France 18, and the United Kingdom 17.[1] The world's two fastest supercomputers are in China, powering specific applications including aerodynamic design for aircraft development, genomics-mapping simulation in the biotech industry, and simulation of wind-turbine selection in the renewable-energy industry, to name but three examples.

China has also been developing core ICT components. Its investment in semiconductors increased from $23.8 billion in 2010 to $55.4 billion in 2016, annual growth of 13 percent. It takes time for science-based innovation to translate into commercial success, but there are signs that China's capacity is growing. When the United States banned the sale of Intel's Xeon chip to Chinese supercomputer labs, China developed a home-grown chip that now powers the world's fastest supercomputer.[2] Chinese scientists developed a chip that can be 2.1 times faster than the normal graphics processing unit.[3] Such huge increases in computing power will be particularly important for China when it reaches the stage of processing huge amounts of data for use in machine learning and AI.[4]

Further development of China's ICT sector is important for the digitization of the economy as a whole. Across economies, ICT sectors appear small. In our US research, we found that official GDP statistics do not reflect the pivotal role that ICT plays as fuel to the broader economy. Its full impact is hard to measure. In the United States, the ICT sector accounted for about 5.0 percent of US GDP in 2014, a little lower than the 5.5 percent share in 1997 despite rapid adoption of digital in the intervening years. This slight reduction in share reflected a 63 percent drop in the price of ICT goods and services between 1983 and 2010.[5] But the spillover effects are enormous. Digital technologies give companies the opportunity to reinvent core processes; create new business models; and boost operational efficiency, engagement with customers, innovation, and the productivity of their workforces. When adoption of digital reaches critical mass, it can fuel intense price competition, shifting profit pools, the breakup of value chains, and the creation of new markets.

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1 Top 500 List (https://www.top500.org/statistics/list/).

2 Brian Barrett, "China's new supercomputer puts the US even further behind," *Wired*, June 21, 2016.

3 Rebecca Tan, "China invests US$1.4 million to develop Cambricon deep learning chips," *Asian Scientist*, April 19, 2017.

4 For more on machine learning, see, for example, Dorian Pyle and Cristina San Jose, "An executive's guide to machine learning," *McKinsey Quarterly*, June 2015.

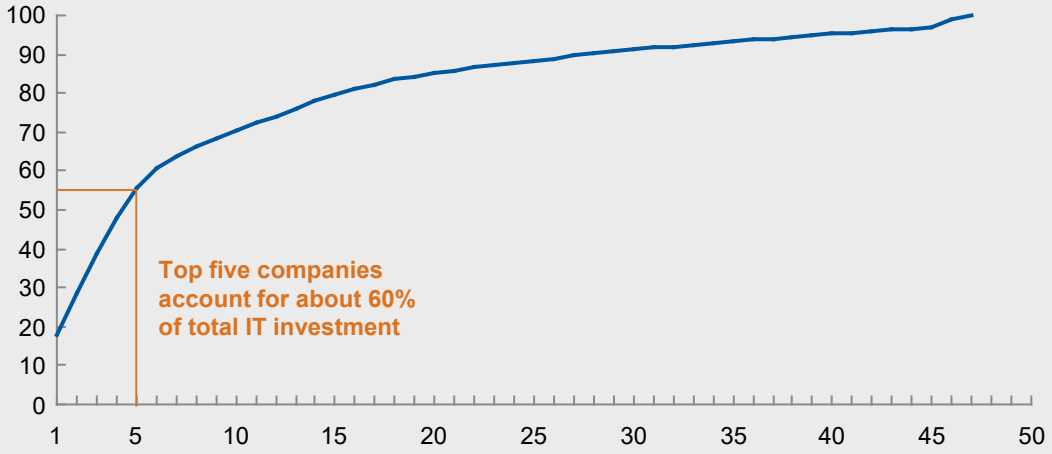
5 *Digital America: A tale of the haves and have-mores*, McKinsey Global Institute, December 2015.

Exhibit 11

A small share of ICT players commands a majority of the industry's IT investment

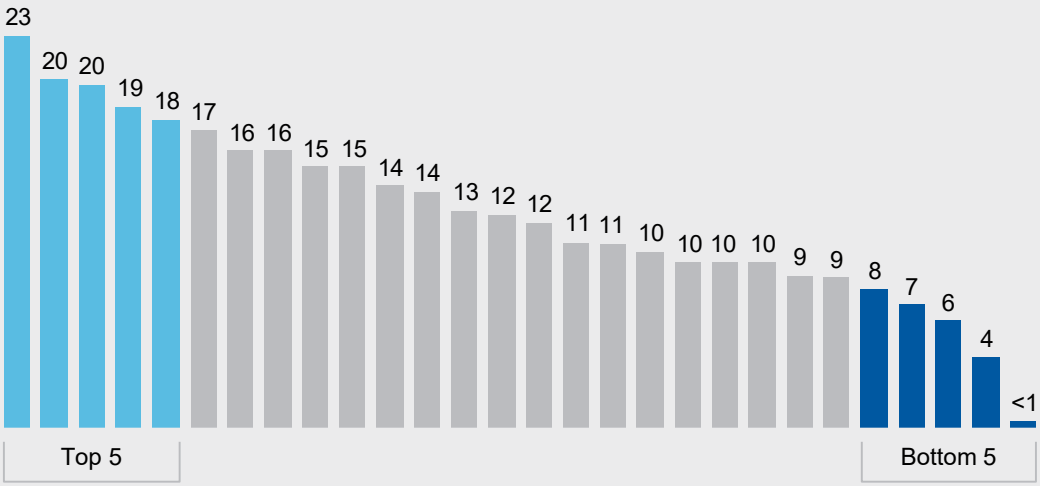
Highly concentrated IT investment

Cumulative IT budget of top 50 ICT companies, 2016
%



Top 30 ICT companies by IT spending per full-time equivalent (FTE) employee

IT budget per FTE, 2016
$ thousand



Average IT budget per FTE, 2016
$ thousand

SOURCE: Kable; McKinsey Global Institute analysis

Time spent on digital media in China up

17.8%

a year in 2011–15; time spent on TV down

0.8%

- **Media.** Over the past decade, the government has been promoting the digitization of the media industry. The State Administration of Radio, Film and Television, which oversees radio, television, and film, has established a China Digital Rights Management Lab that aims to create a healthy ecosystem for providers and publishers of digital content. Broadcasting programs and advertisements are digitized, and China's upgrade of the television signal from analog to digital has driven increased spending on infrastructure. In 2012, the authority spent 1.5 billion renminbi ($226 million) on subsidizing the installation of digital television sets in households in rural China.[77] Widespread adoption and use of mobile devices has also contributed to the emergence of digital media. By 2015, Chinese adults were engaged in digital media for three hours a day—more than the time they spent watching traditional television. Time spent on digital media increased by 17.8 percent a year between 2011 and 2015, while time spent watching television declined by 0.8 percent. The mix of advertising also reflects this shift to digital. In 2015, Chinese advertisers allocated 51 percent of their budgets to digital media, but only 32 percent to traditional television.[78]

- **Finance.** Like other economies around the world, China spends a substantial amount on financial IT. Banks increasingly acknowledge that they need to invest in customer relationship management solutions to maximize the value of customer life cycles, big data and analytics solutions to improve risk management and operational efficiency, and cybersecurity solutions to ensure the safety of their sites and their data. China's big four banks spent $8.5 billion on IT in 2016, compared with $6.4 billion in 2012 (annual growth of 7 percent), according to the International Data Corporation. Regulations covering finance in the 13th Five-Year Plan announced in 2015 encourage the sector to use technology to improve the security of personal information; IT solutions related to compliance; and online payments, money transfer, and cross-border e-commerce payments.[79] Internet finance has grown rapidly, reaching 12 trillion to 15 trillion renminbi ($1.8 trillion to $2.3 trillion) in 2015, or nearly 20 percent of China's GDP. The number of people using internet finance is now around 500 million—the most of any country in the world. P2P lending volume is more than 350 billion renminbi ($53 billion).[80] Digital attackers have emerged, which has increased competitive pressure on traditional banks to boost their investment in digital solutions. Chinese financial institutions generally have sufficiently deep pockets to finance considerable investment. The return on investment of Chinese banks tends to be between 15 and 20 percent, compared with only around 9 percent in the case of US banks and about 3 percent for banks in the EU.[81]

[77] Lang Lang, "SARFT promotes digitalization with satellites," *21st Century Business Herald*, March 20, 2012 (http://tech.ifeng.com/telecom/special/2012ccbn/content-3/detail_2012_03/20/13310707_0.shtml).

[78] "Digital overtakes traditional media in China, but TV consumption holds strong," eMarketer, April 27, 2016.

[79] Wu Xiaobo, "Chinese banks' IT spending to hit $20b by 2020: IDC," *China Daily*, June 2017; "Goals, missions of China's new five-year plan," Xinhua, March 5, 2016.

[80] Joseph Luc Ngai et al., *Disruption and connection: Cracking the myths of China internet finance innovation*, McKinsey Greater China FIG Practice, July 2016.

[81] Ibid.

45%
of Chinese retailers had online sales channels in 2016 from
25%
in 2014

Cluster 2. Consumer-facing industries are further ahead of other sectors on digitization in China than they are in other countries

The relative ranking on digitization of China's consumer-facing industries is, as we have noted, much higher than in either the United States or the EU. This reflects rapid and widespread adoption of digitally enabled commerce by consumers, as we described in Chapter 1.

- **Entertainment and recreation.** China is one of the largest entertainment markets in the world. As consumers increasingly use online and digital solutions, entertainment companies are investing in digital assets. Event tickets are sold on a range of platforms, from specialized entertainment ticketing platforms such as Damai, e-commerce platforms, and secondhand trading platforms such as 58.com. More than half of event tickets were sold through digital channels in 2016 (75 percent in the case of movie tickets), according to iResearch estimates. Live streaming of performance and events is also gaining popularity. In 2015, one online platform streamed 367 music concerts and festivals, claiming 200 million views. [82]

- **Retail trade.** The penetration of e-commerce has accelerated over the past decade, from only around 1 percent of total retail in 2006 to 15 percent in 2016. In the same period, growth in the penetration of e-commerce happened at a more moderate pace in the United States (from 3 percent to 8 percent) and in Germany (from 2 percent to 7 percent).[83] Sixty-four percent of China's internet users shopped online in 2016.[84] It is therefore vital for retailers and their suppliers to have an online presence, and they are investing heavily in digital ways to engage and transact with customers. By 2016, about 45 percent of retailers in China had developed online sales channels, up from just 25 percent in 2014, according to the China Internet Network Information Center. Alibaba's platform alone has about ten million active sellers.

Cluster 3. Government-related industries invest heavily in digital assets

Government-related sectors in China have been investing heavily in digital assets, and government ranks far higher in relative terms on the MGI Industry Digitization Index than it does in the United States or the EU. Nevertheless, government's use of digital assets in China still lags behind that of leading clusters.

- **Utilities.** China's electric-power industry surpassed that of the United States in 2011 to become the world's largest producer of electricity. Utilities have been putting considerable effort into digitization in order to improve efficiency and business processes. China became the world's largest market by investment for smart grids in 2013, when $4.3 billion, or more than one-quarter of global spending, poured into the technology.[85] China also has a plan to invest $58 billion by 2020, according to China's National Energy Administration. A large share of this investment will go into smart meters. In 2015, about 310 million households were using smart meters, a penetration rate of more than 80 percent compared with 56 percent in 2013.[86] Gas and water utilities are also adopting connected meters to increase efficiency.

82 Tracey Xiang, "Live concert streaming is taking off in China," TechNode, January 22, 2016.

83 iResearch; eMarketer; National Bureau of Statistics.

84 *China statistical report on internet development*, China Internet Network Information Center, January 2017 (http://cnnic.cn/hlwfzyj/hlwxzbg/hlwtjbg/201701/P020170123364672657408.pdf).

85 Feng Xiufeng, *Smart grids in China: Industry regulation and foreign direct investment*, The Energy Bar Association, May 16, 2016.

86 *Smart meters may reach nationwide coverage in 2017*, CK365, March 6 2014 (http://www.ck365.cn/news/7/33550.html).

- **Health care.** IT spending by China's health-care institutions has increased rapidly, from 15 billion renminbi ($2.3 billion) in 2011 to an estimated 34 billion renminbi ($5 billion) in 2016, an annual growth rate of 18 percent.[87] Hospitals have been also digitizing their processes. Nurses in 75 percent of China's hospitals use a workstation system in inpatient departments to manage information, including physicians' orders and patients' medical records, and more than 70 percent of hospitals have adopted digitized workstation systems for physicians in both inpatient and outpatient departments.[88] Patients are also embracing digital processes. For instance, in 2016, 410 million hospital appointments were made through the online appointment platform Weiyi, up from only 72 million in 2013. This platform is connected to more than 2,400 hospitals in 29 provinces and 260,000 affiliated physicians.[89]

- **Government.** Although China ranks only 63rd out of 193 countries on the United Nations's e-government index, it has been increasing its investment in digitizing government operations and the channels it uses to engage with citizens. By the first quarter of 2017, the Ministry of Public Security had issued 98 million biometric passports. Travel permits in Hong Kong and Macao are fully digital, and 30 percent of residents of mainland China use an automated clearance system to enter or leave Hong Kong and Macao.[90] The State Administration of Taxation has established a nationwide online tax-service platform, 12366, to help make tax reporting and advisory services more efficient. Many cities, including Beijing, Chongqing, and Shanghai, have websites that give citizens free access to a range of government data. The Beijing website offers access to more than 400 data sets covering areas such as education, land-use zoning, tourism, and transportation (for instance, maps of bus lines).[91] On the Ministry of Environmental Protection's website, people can give their opinions on draft documents.

170M
users of online education platforms for children's education

- **Education.** China has about 180 million students enrolled in primary to higher education, and demand for education is rising—citizens devote a large share of their incomes to equipping their children for the future.[92] To meet this demand, spending on education increased from 2.82 percent of GDP in 2005 to more than 4.5 percent in 2015, exceeding the government's target of 4.0 percent of GDP by 2012.[93] The government has also been investing in improving IT facilities and multimedia classrooms in schools and colleges. Eighty-seven percent of elementary and middle schools have internet access, and 80 percent of classrooms are equipped with multimedia facilities.[94] China's online education market has also been growing. Its revenue hit 45.84 billion renminbi ($6.64 billion) in the first quarter of 2017, a year-on-year increase of 65 percent. The number of monthly users of online education platforms is 170 million for children's education, 95 million for foreign language learning, and 45 million for professional education.[95]

87 Qianqian Song, *Report on medical informatization in the software industry*, Sealand Securities, March 29, 2016 (http://pg.jrj.com.cn/acc/Res/CN_RES/INDUS/2016/3/29/03334fff-cdfe-4ca9-9076-664f2450297c.pdf).

88 *Survey on digitization of Chinese hospitals*, Information Management Committee, Chinese Hospital Association, September 2015.

89 Company website (https://www.guahao.com/about).

90 *98 million biometric passports have been released in China*, xinhuanet, April 1, 2017 (http://news.xinhuanet.com/fortune/2017-04/01/c_1120739603.htm).

91 Beijing government data website (http://www.bjdata.gov.cn/index.htm).

92 *2005 National education expenditure implementation statistics bulletin*, Ministry of Education, December 29, 2016 (http://www.moe.edu.cn/jyb_sjzl/s5990/201612/t20161219_292432.html).

93 *2015 National education expenditure implementation statistics bulletin*, Ministry of Education, December 29, 2016 (http://www.gov.cn/shuju/2016-11/10/content_5131034.htm).

94 *13th Five-Year Plan for educational informationization*, Ministry of Education, June 7, 2016 (http://www.moe.gov.cn/srcsite/A16/s3342/201606/t20160622_269367.html).

95 *China online education market overview for Q1 2017*, China Internet Watch, May 16, 2017.

27%
of global purchases of industrial robots in 2016 by China

Cluster 4. Capital-intensive industries tend to lag behind other sectors on digitization

In capital-intensive industries around the world such as oil and gas and advanced manufacturing, digital spending is relatively marginal as a share of total spending. At the same time, these industries require close collaboration between upstream and downstream companies, and supply chains tend to become digitized.

- **Advanced manufacturing.** Transactions and interactions between suppliers and customers are largely digitized, given the importance of supply-chain collaboration in product development and manufacturing operations. However, China has been investing less than key advanced economies in digital and automation solutions. The density of robots in China is 49 per 10,000 employees, compared with 176 in the United States and 305 in Japan, according to the International Federation of Robotics. In the automotive industry, China's robot density is 305 per 10,000 employees, compared with 1,141 in the United States. The Chinese government appears determined to accelerate digitization and automation. Its Made in China 2025 plan includes a goal of boosting robot density to 150 per 10,000 employees by 2020. Reflecting the determination to catch up in this area, in 2016, China accounted for 27 percent of global purchases of industrial robots, making it by far the biggest buyer. In 2015 alone, the government of Guangdong, one of China's advanced manufacturing hubs, invested $150 billion to encourage automation and foster robotics innovation.[96]

- **Oil and gas.** Three large SOEs employing around two million people dominate China's oil and gas sector. However, their output per employee is only 10 to 30 percent of the figure for their Western counterparts.[97] Many factors may be behind this gap, one of which appears to be that China's oil and gas industry has not embraced the power of digital solutions to boost productivity to the same extent that its counterparts in advanced economies have. Digitization has not been high on the agenda of executives who have tended to focus instead on management practices, operational improvement, and ensuring access to resources, for example. IT spending as a share of revenue among the leading Chinese oil and gas companies stands at around 0.2 percent, compared with 1.0 to 1.5 percent among leading global companies. Yet there are many ways to boost the productivity of oil and gas and other resource companies. Digital solutions can, for instance, help companies develop better understanding of the resource base through sensor technology and advanced analytics during the exploration and planning phase. Once an operation is up and running, real-time data and analytical engines can improve scheduling and processing decisions in order to maximize utilization of equipment and boost yields. Automation can make processing more efficient, and sensor technology and statistics-based predictive analysis can improve anticipation of failures and facilitate preventative maintenance, reducing costly breakdowns.[98]

- **Chemicals, pharmaceuticals, and the manufacture of basic goods.** Investment in digitization in these sectors tends to be relatively low, and there are large differences in the degree of digitization among multinational corporations active in China and local players.

96 Zi Yang, "Who will satisfy China's thirst for industrial robots?" *The Diplomat*, May 19, 2017.

97 Eric Ng, "China needs 'Big Bang' reform of oil and gas industry to remain globally competitive," *South China Morning Post*, September 4, 2016.

98 *Digital Australia: Seizing the opportunity from the Fourth Industrial Revolution*, Digital McKinsey, May 2017.

Cluster 5. Localized and fragmented sectors lag behind other sectors on digitization

The real estate, construction, agriculture, personal and local services, and hospitality sectors tend to be largely local, and fragmented. Reflecting these characteristics, the sectors tend to lag behind others on digitization. However, this leaves huge scope for digitization that will make these sectors more competitive and boost their productivity. Digital innovators are already beginning to disrupt these industries.

In real estate, companies tend to rely on offline business processes such as leasing and rental, and transactions are largely not digitized. Given that properties are big-ticket items and non-standardized products, physical visits to locations and offline interactions with sales professionals are necessary. In construction, in China and around the world, digitization is low and players focus less on digital solutions than on other ways of driving operational efficiency. Chinese developers have generated substantial returns in recent decades by obtaining the right land on which to build and completing projects as quickly as possible. Another disincentive to digitization in Chinese construction in the 1980s and 1990s was an abundance of highly motivated and cheap workers from rural areas, but wages in construction are now rising, and this may change priorities. Agriculture remains highly labor-intensive, and farms are small—on average, each farmer controls only around 0.6 acre. There is little incentive (or money) to digitize, although a few large corporations have the standardized processes and business scale that could support and enable digitized management. The hospitality industry is fragmented and spends relatively little on IT, although transactions are relatively digitized. For example, 36 percent of consumers used mobile payments for their food consumption at restaurants in 2016, up from just 10 percent in 2015.[99]

36%
of Chinese consumers used mobile payments for food consumption in 2016

Even in these sectors, however, some companies are adopting digital solutions to tackle inefficiencies and improve service to customers. In real estate, for instance, the consumer journey is becoming digitized. Digital companies such as Anjuke.com and Fang.com offer real-time listings of houses for sale and rent. Fang.com, which had 80 million users and 4.5 million real estate agencies on its platform by the end of 2016, also offers housing-finance options and a house furnishing forum. Residential property company Vanke has developed an online platform and mobile app that connect real estate agents and buyers, which complements its standard services, including property maintenance. Property developers such as Intime Mall, Joy City, and Wanda are investing in digitizing shopping malls, for example setting up beacons that collect and analyze customer data so that shop owners can improve their sales and marketing. In agriculture, COFCO, a supplier and processor of grains, oil, sugar, and cotton, has set up the e-commerce site Womai.com to sell fresh and processed food directly to customers. Also in agriculture, New Hope group is using IoT technology to collect information about the weather that enables the company to control the temperature and humidity level at its cattle farm, thereby increasing efficiency. In the hospitality sector, hotel chain Hanting has developed a mobile app for booking and digital check-in and checkout.

•••

As in other countries, the digitization of sectors in China varies widely. Overall, digitization in China lags behind that of the EU and the United States, but that gap is narrowing—and narrowing rapidly. In Chapter 3, we turn to a detailed discussion of the impact of three major digital forces on four sectors of the Chinese economy.

[99] *Food and beverage consumption report*, China Cuisine Association, December 25, 2016 (http://www.ccas.com.cn/Article/HTML/108083_3.html).

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3. THREE DIGITAL FORCES ARE RESHAPING VALUE CHAINS

MGI has undertaken wide-ranging research on the impact of digital technologies on the global economy, including the economy of China (see Box 5, "How we define digitization"). A number of macro-level reports have assessed the size of the digital economy and the economic value these technologies create.[100] In 2014, MGI found that up to one-fifth of China's economic growth and productivity in the period to 2025 could come from digital applications.[101] In 2015, MGI found that innovation in its broadest sense will need to contribute up to half of GDP growth by 2025, or $3 trillion to $5 trillion a year.[102] In 2016, China's digital economy accounted for about 30 percent of the nation's GDP, and it is expected to reach 35 percent by 2020, according to a report by the China Academy of Information and Communications Technology and the Ministry of Industry and Information Technology.[103]

At the micro level, the performance and valuation of digital companies has risen sharply. Five of the top ten US companies by valuation are technology and internet firms. Tencent and Alibaba are among the ten most valuable companies in China; six others are in banking, and the other two are in the energy sector, where SOEs are strong.

These macro and micro developments prompted us to ask new questions. How does digital shake up the status quo? How do digital technologies create new winners and losers? What choices can incumbents make? How is China's digitization similar to and different from that of the rest of the world?

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[100] MGI reports on digitization, which can be downloaded free at www.mckinsey.com/mgi, include *Artificial intelligence: The next digital frontier?* June 2017; *Artificial intelligence: Implications for China*, April 2017; *China's role in the next phase of globalization*, April 2017; *A future that works: Automation, employment, and productivity*, January 2017; *China's choice: Capturing the $5 trillion productivity opportunity*, June 2016; *The China effect on global innovation*, October 2015; *China's digital transformation: The internet's impact on productivity and growth*, July 2014; *The age of analytics: Competing in a data-driven world*, McKinsey Global Institute and McKinsey Analytics, December 2016; and *Big data: The next frontier for innovation, competition, and productivity*, 2011.

[101] *China's digital transformation: The internet's impact on productivity and growth*, McKinsey Global Institute, July 2014.

[102] *The China effect on global innovation*, McKinsey Global Institute, October 2015.

[103] *White paper on digital economy development*, China Academy of Information and Communications Technology, July 2017 (http://www.chinadaily.com.cn/business/2017-07/20/content_30179729.htm).

Box 5. How we define digitization

Our use of the term *digitization* encompasses three aspects and their relative measures: **digitization of assets**, including, for instance, infrastructure, connected machines, data, and data platforms; specific technologies that MGI has discussed in its wide-ranging research on digitization and that are discussed in this report include the internet, big data analytics, robotics, IoT, VR, AR, and 3-D printing; **digitization of operations**, including processes, payments and business models, and customer and supply chain interactions; and **digitization of the workforce**, including workers' use of digital tools, digitally skilled workers, and new digital jobs and roles. The three aspects belong together—on their own, digital investments are unlikely to yield results. In measuring each of these aspects, we find relatively large disparities across companies, sectors, and countries.

In seeking answers, we have focused our research on how three digital forces—disintermediation, disaggregation, and dematerialization—are reshaping value chains and, in the process, boosting productivity. As China digitizes, industries will experience huge shifts in revenue and profit pools across the value chain, doubtless creating disruption that will create losers and winners—and disproportionate value for the latter.[104] This value shift and creative destruction is happening around the world as digitization sweeps across economies, and it is likely to be on a relatively large scale in China given its particular combination of inefficiencies in traditional sectors and massive potential for commercialization. Those players that emerge as winners are likely to be of sufficient scale to influence the global digital landscape and to inspire digital entrepreneurs far beyond China's borders.

To assess how digitization is reshaping industries in China, in this chapter we look in some detail at four sectors that offer different opportunities: consumer and retail; automotive and mobility; health care; and freight and logistics. We analyzed about 300 use cases in these four sectors, and assessed how the three major digital forces can reshape value chains and improve productivity.

DIGITAL FORCES CAN POTENTIALLY SHIFT (AND CREATE) 10 TO 45 PERCENT OF THE INDUSTRY REVENUE POOL ACROSS PLAYERS BY 2030

Digital can shift (and create)
10–45%
of industry revenue pool by 2030

Our simulation suggests that digitization can potentially shift, and create, value equivalent to 10 to 45 percent of industry revenue pools by 2030 in the four sectors analyzed (Exhibit 12 and Box 6, "How we simulated the impact of digital forces reshaping value chains"). In addition, companies can use digital levers to improve productivity, which could potentially have an impact equivalent to 3 to 14 percent of the value of the revenue pools of the four sectors.[105]

- **Consumer and retail.** We assessed the consumer and retail sector because this was one of the earliest to digitize in China, reflecting the e-commerce revolution. We expect an even more significant transformation to unfold in the years ahead. In particular, digital platforms will drive the evolution of new retail models characterized by omnichannel approaches and data-driven business models.

- **Automotive and mobility.** We chose the automotive and mobility sector to test whether—and how—digitization, technological advances, and new business models can change an advanced manufacturing sector. Digital channels and car connectivity can redefine the dynamics affecting component suppliers, technology solution providers, dealerships, and consumers. We expect to see a continuation of an ongoing shift from an ownership model to a service-driven one: shared mobility. Integrated mobility solutions and autonomous vehicles are likely to transform the way people travel in cities.

[104] Jacques Bughin, Laura LaBerge, and Anette Mellbye, "The case for digital reinvention," *McKinsey Quarterly*, February 2017.

[105] For the consumer sector, we analyzed consumer-goods categories such as food and beverages, apparel, consumer electronics, and personal care. For retail, we analyzed online and offline retailers such as supermarkets, hypermarkets, and department and convenience stores (excluding automotive retail). For automotive and mobility, we largely focused on the impact on passenger vehicles and transportation solutions. In our integrated mobility model, we also considered the impact on public transportation. We excluded impact on commercial transportation such as trucks, which we assessed in our analysis of freight and logistics. For health care, we largely analyzed the impact on payors, pharmaceutical and medical-technology companies, health-care-service providers, and providers of digital solutions. For freight and logistics, we mainly focused on three subsectors: freight forwarding, road transportation, and express delivery.

- **Health care.** We analyzed the health-care sector because, although it has huge potential for digital disruption, it has been one of the slowest to adopt digital technologies thanks to players' differing interests and incentives. If a "big-bang scenario" were to happen in China's health-care system that combined significant developments such as health-care big data, AI-empowered treatment, and IoT–enabled services, the impact could be larger than in any other sector we analyzed.

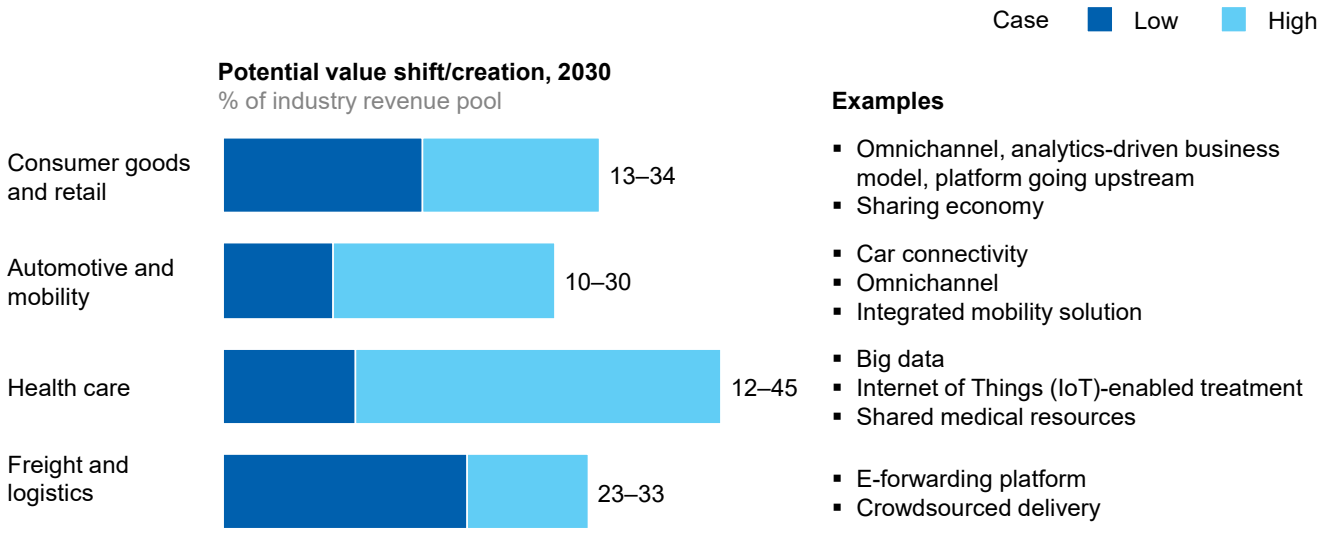
- **Freight and logistics.** We chose this sector because it is highly inefficient and relatively less digitized in China than elsewhere, despite the fact that there are many factors that could drive very large-scale digitization. The digitization of intermediaries (forwarding companies) and last-mile delivery (through crowdsourcing) has the potential to improve utilization dramatically while improving services for customers.

Our analysis of these four sectors focuses primarily on the role of digital in restructuring value chains because extensive MGI research has previously analyzed the productivity upside.[106] We briefly discuss the potential for productivity gains at the end of this chapter.

Exhibit 12

Digital forces can shift (and create) between 10 and 45 percent of the industry revenue pool across players by 2030

SIMULATION



SOURCE: McKinsey Global Institute analysis

[106] See, for instance, *The Internet of Things: Mapping the value beyond the hype*, McKinsey Global Institute, June 2015; *Global growth: Can productivity save the day in an aging world?* McKinsey Global Institute, January 2015; and *China's digital transformation: The internet's impact on productivity and growth*, July 2014.

Box 6. How we simulated the impact of digital forces reshaping value chains

Predicting digital disruption is perilous. By definition, such disruption unfolds in unexpected ways. Moreover, in cases where digital disruptions are in their early stages, historical data are insufficient for a rigorous econometric assessment. Even in industries where the first wave of digital disruption has already happened, it is highly uncertain whether the same formula and pattern can be replicated in other sectors.

In this research, we did not attempt to predict digital disruption but tried to simulate the potential value shift and creation in value chains that could result from three key digital forces: disintermediation, disaggregation, and dematerialization. We simulated where new digitally driven business models may emerge, and how each part of the value chain could be affected. Given that every sector (and subsector) has very different industry characteristics, competitive landscape, technology adoption, customer attitudes, and regulatory environment, our view is that we can simulate disruption only by taking a micro view at the sector level. We used the following steps.

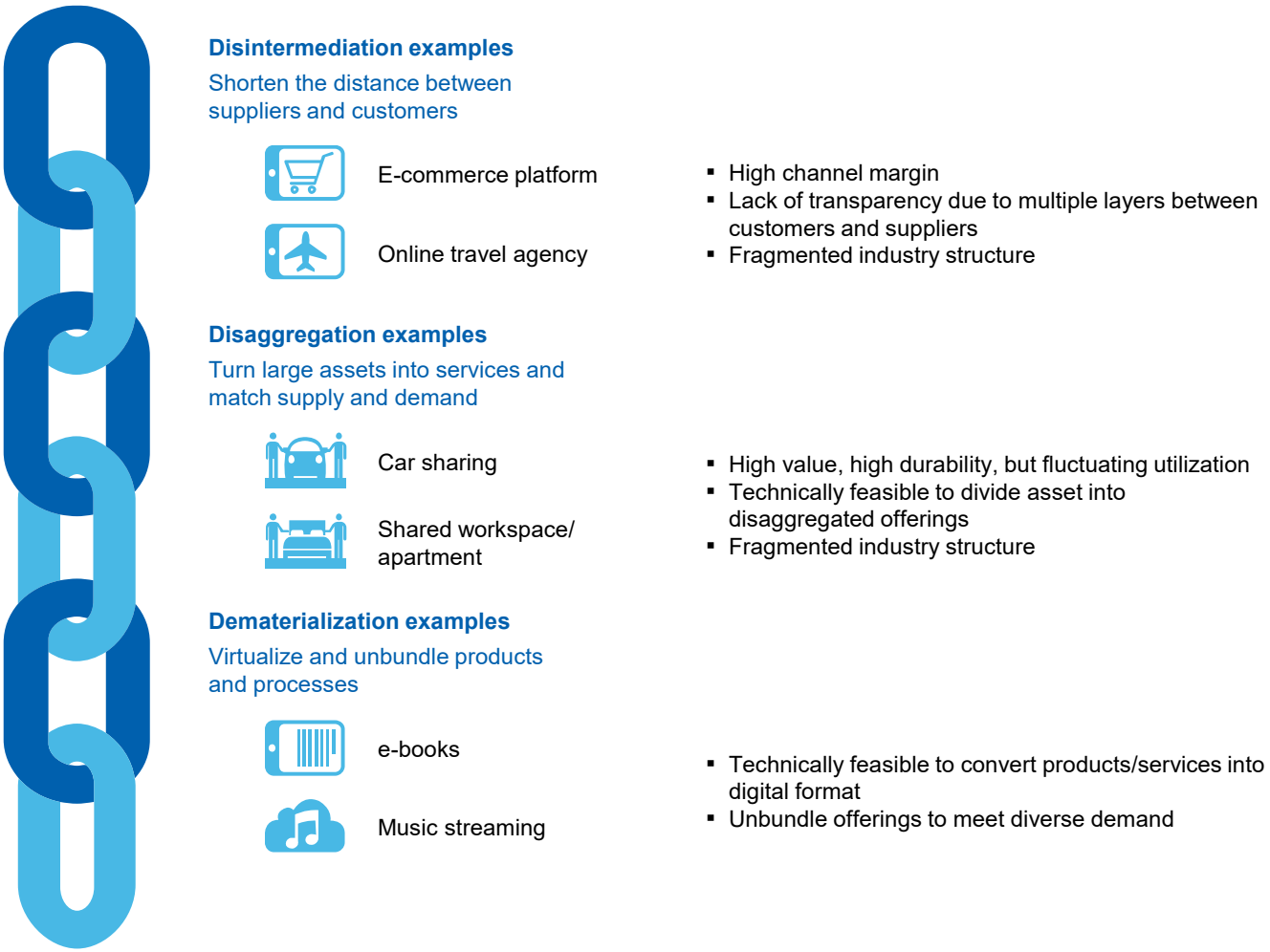
- **Step 1.** We identified use cases in different industries and analyzed about 300 cases in the four sectors, prioritizing those that reflected the three digital forces.
- **Step 2.** For each use case, we simulated the potential penetration or adoption of digital by 2030, which can lead to a shift in revenue among industry players. For example, increasing e-commerce shifts consumer traffic from offline to online; higher adoption of shared mobility implies declining growth in new car sales; and IoT- and AI-enabled health care may reduce patient flow to traditional hospitals. For each use case, we modeled a related value shift from traditional business models or incumbent players (offline retail, automotive OEMs, and hospitals, for example) that are in a position to be attacked by providers of new digital solutions (digital e-commerce platforms, shared mobility companies, and providers of IoT solutions, for example). We also modeled the impact on different groups of players along the value chain (a decline in new car sales will have an impact on automotive dealers, for example). We also simulated the creation of new revenue. For example, the adoption of analytics solutions with powerful recommendation engines in consumer and retail can drive incremental consumption by unleashing unmet demand.
- **Step 3.** To assess the size of revenue shift and creation in the four sectors, we quantified the impact as a percentage of each industry's revenue pool, generally expressing this as "equivalent to" a certain percentage of that pool.
- **Step 4.** Finally, we calculated the implied impact on the labor market (see Chapter 4). We divided the amount of value shift and creation by the labor productivity of each stakeholder in each sector to assess the impact on jobs.

As part of this analysis, we interviewed more than 100 industry experts, conducted benchmarking analysis, and used McKinsey's proprietary data set including consumer and industry surveys. It is important to note that that our simulation is not a "zero-sum" assessment, but rather an attempt to assess relative gains among incumbents that are slow to react and digital attackers that can offer a competitive value proposition. In reality, as the overall economy grows, most industry stakeholders can gain value and grow. For example, even if shared-mobility solutions were to lead to reduced demand for new cars, the automotive industry would continue to expand as car ownership by China's growing middle class continues to increase. Likewise, even if e-commerce continues to penetrate, offline retailers could still grow as consumption in the economy increases and modern retail models penetrate further into smaller cities. Moreover, we recognize that incumbents can be proactive in adopting digital business models that disrupt their own traditional business, thereby losing value but at the same time capturing upside.

We now briefly describe the three types of digital force that can disrupt and restructure value chains—sometimes in combination, thereby increasing the speed of the disruption (Exhibit 13 and Box 7, "The pattern of impact of the three digital forces differs by sector").

Exhibit 13

Digitization of industries can produce three types of value chain restructuring


Value chain restructuring
Characteristics of vulnerable industries
Disintermediation examples
Shorten the distance between suppliers and customers
E-commerce platform
Online travel agency
High channel margin
Lack of transparency due to multiple layers between customers and suppliers
Fragmented industry structure
Disaggregation examples
Turn large assets into services and match supply and demand
Car sharing
Shared workspace/ apartment
High value, high durability, but fluctuating utilization
Technically feasible to divide asset into disaggregated offerings
Fragmented industry structure
Dematerialization examples
Virtualize and unbundle products and processes
e-books
Music streaming
Technically feasible to convert products/services into digital format
Unbundle offerings to meet diverse demand

SOURCE: McKinsey Global Institute analysis

Disintermediation shortens the distance between suppliers and customers

Companies such as Amazon and Alibaba have disrupted the retail industry by cutting out a middle layer and linking suppliers and consumers directly through digital platforms: disintermediation. Industries with high margins on digital channels, a lack of information transparency due to multiple layers between suppliers and customers, and a highly fragmented landscape are ripe for this type of digital disruption. Digital platforms play an important role in directly matching suppliers and customers, a function that can substantially improve transparency across the value chain.

Disintermediation has had a marked effect on offline retail. In the United States, for instance, segments of the retail sector have either stagnated or shrunk over the past decade. In the consumer-electronics category, for instance, offline retail grew by 2 percent between 2003 and 2016, but e-commerce grew about five times faster, at 11 percent per year, according to Euromonitor. E-commerce now accounts for 38 percent of US electronics retail, up from

16 percent in 2003. Similar trends have been observed in the travel sector, where online hotel bookings have grown significantly and the number of human travel agents has fallen by half since 2000.

As the rapid growth of e-commerce indicates, disintermediation has been a major trend in China, too. Where there are inefficiencies linking suppliers and customers in an industry, disintermediation will continue. The increasing use of digital platforms and omnichannel by consumers effectively removes any barriers between online and offline, and we are likely to see similar disintermediation spread to other sectors. For instance, in the automotive sector, it is increasingly possible for consumers to choose, buy, and service a car entirely digitally, challenging the traditional dealership model. In health care, IoT and AI enable remote monitoring and self-management of health and treatments, improving access to and quality of care, but also disintermediating traditional care delivery by hospitals.

Disaggregation turns large assets into services, matches supply and demand

Digital attackers are disrupting traditional business models and reinventing industries by disaggregating huge assets into many pieces, turning them into services, and meeting the needs of fragmented consumer bases. They charge for the use of owned assets and unlock unused supply. Industries that have high value, high durability, and fluctuating utilization are ripe for this type of disruption. Digital platforms can offer multisided solutions that enable the rapid expansion of supply while meeting underserved demand.

In the property sector, companies such as Airbnb and WeWork are disaggregating high-value residential and commercial properties into fragmented units that can be rented to end-users in a flexible way. The number of rooms offered by Airbnb has increased rapidly and now stands at three million listings in 65,000 cities in more than 191 countries.[107] New York-based WeWork offers shared workspace, office facilities, and services for startups. As of 2016, the company had 110 locations around the world, had doubled its presence with the addition of 18 cities in six new countries, and had doubled its membership to more than 80,000 people.[108] In transportation, companies such as Uber and Lyft are rewriting the rules with mobile ride-hailing solutions.

Digital disruption through disaggregation is increasingly prominent in China. Ride-hailing service Didi Chuxing now serves 360 cities and arranges three million rides per day, accounting for 86 percent of the market, according to Analysis International. The company also offers P2P private car services in 80 cities.[109] The sharing economy in the property sector has also emerged in China but has evolved in a way that addresses local needs. For example, China has many vacant homes that were purchased as investments. Affluent homeowners are reluctant to rent to tourists with whom they are unfamiliar. Given this, local companies such as Tujia offer value-added services like due diligence of property listings, and hotel-like management services such as housekeeping. This reassures travelers about the quality of the property and gives peace of mind to owners, who tend to live far away from their investment properties.[110]

Disaggregation can continue to happen in many other sectors. In the consumer-goods industry, the shared-economy model may come to include highly valued, highly durable products such as jewelry and bags. In health care, shared physical resources and facilities are emerging in a bid to optimize the matching of the supply of resources and patient demand, thereby improve accessibility, the quality of treatment, and the utilization of facilities. In freight and logistics, crowdsourcing-based models are emerging to meet

[107] Company website (www.airbnb.com)

[108] Company website (www.wework.com).

[109] Company website (http://www.xiaojukeji.com/en/index.html).

[110] See, for instance, Adam Minter, "Why Airbnb won't conquer China," Bloomberg View, March 23, 2017; and Sherisse Pham, "China's big Airbnb rival is taking the battle overseas," CNN Tech, June 2, 2017.

demand for last-mile delivery. In fact, China has an ambitious target to promote the sharing economy for use in products, services, capital, knowledge, skills, and production capacity. The sharing economy is expected to reach 10 percent of GDP by 2020 and 20 percent of GDP by 2025, according to a report published by China's State Information Center.[111]

Dematerialization is the virtualization and unbundling of products and processes

Dematerialization or virtualization means changing the formats of products (or processes) from physical to virtual, unbundling demand with digital delivery, and enabling consumers to receive products or services anywhere, anytime. It typically happens in industries where it is technically feasible to convert products and services into digital formats and to unbundle offerings to meet a range of customer demands.

In the music industry, dematerialization has led to a number of waves of disruption. In 1998, when the MP3 was first introduced, consumers shifted in very large numbers to the digital format. Sales of physical music products fell from $20 billion to $6 billion (an 11 percent annual decline) between 1998 and 2008, while digital download sales increased from almost zero to $3 billion over the same period. Since the late 2000s, a new wave of dematerialization has emerged: streaming. Streaming has slowed the pace of growth in digital downloads, from $2.7 billion to $3.1 billion, while the value of streaming services increased rapidly, from $200 million to $800 million (28 percent annual growth) between 2008 and 2013.[112] Trends have been similar for electronic books offered by companies such as Amazon, which have dramatically changed consumers' reading habits. Sales of electronic readers increased from $1.2 billion to $3.6 billion (45 percent annual growth) between 2010 and 2013, while sales of printed books dropped from $19 billion to $15 billion (a 7 percent annual decline).

$300M
revenue from digital music downloads in China in 2016

In China, the pace of conversion from physical to digital formats has been much faster, and the upside for digital attackers a great deal larger, than in other countries. In the music industry, for instance, revenue from physical records plummeted from $79 million to $21 million between 2007 and 2016 (a 13.5 percent annual decline). During the same period, growth in digital downloads exploded from $77 million to $300 million (16 percent annual growth). While overall revenue in the music industry in the United States has declined, in China that figure has grown from $156 million to $355 million (9.6 percent annual growth). This reflects the fact that China is still a growing market as well as improvements in the legal framework to support intellectual property.

The evolution of e-books in China has played out differently than in the United States. The market for internet-based literature that can be purchased and viewed on PCs or smartphones is five times larger than the market for e-reader devices. This may reflect the fact that Chinese consumers tend to use mobile devices to read literature instead of buying dedicated devices, and then share with friends through their social networks, thus generating additional traffic.[113] Another difference from the United States is that, in China, print and electronic formats have both grown rather than cannibalizing each other.

Many types of technologies can drive the dematerialization of products and services. In our simulation, we largely concentrated on the dematerialization of physical products or processes, focusing on technologies such as 3-D printing, AR, and VR.

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[111] *China's sharing economy development report*, State Information Center, February, 2017 (http://english.gov.cn/state_council/ministries/2017/03/23/content_281475604274591.htm); Zhong Nan, "Report says China's sharing economy to grow 40% annually," *China Daily*, March 23, 2017.

[112] Wilkofsky Gruen Associates.

[113] *Current situation and new trends of China e-book market*, Douban, July 6, 2016 (https://site.douban.com/210084/widget/notes/13298573/note/568543520/).

Box 7. The pattern of impact of the three digital forces differs by sector

Although patterns differ by industry, of the three digital forces restructuring value chains, disintermediation and disaggregation are the major ones in terms of impact on the four sectors studied (Exhibit 14).

As noted in Chapter 2, China's overall score on MGI's Industry Digitization Index lags behind that of the EU and the United States. Many businesses in China still operate in a traditional environment; industries are fragmented, information is opaque across the value chain, and executives often lack the sense of urgency needed to persuade them to change their operating model. Disintermediation can be a powerful way to shake up the status quo by shortening the distance between suppliers and customers, taking out inefficiencies, and enabling new attackers unburdened by heavy offline legacies to enter the market and create healthy competition. Attackers can win value from defensive incumbents and can create new value—sometimes in the form of consumer surplus such as free services, convenience, or lower prices.

Disaggregation is another major force, and is particularly potent in the automotive and health-care sectors. In transportation, shared mobility has been penetrating rapidly because it offers a clear value proposition to consumers—a cheap and convenient solution to meeting their transportation needs. In health care, digital solutions can aggregate fragmented data to build big data, and then disaggregate those data so that, for instance, payors can track treatments and develop personalized plans for patients. In consumer and retail, a great deal of experimentation is under way. However, disaggregation may not be as large a disruptive force as disintermediation because, for instance, consumers may be reluctant to share some items, such as toys (because of perceived hygiene issues), and may be concerned about theft.

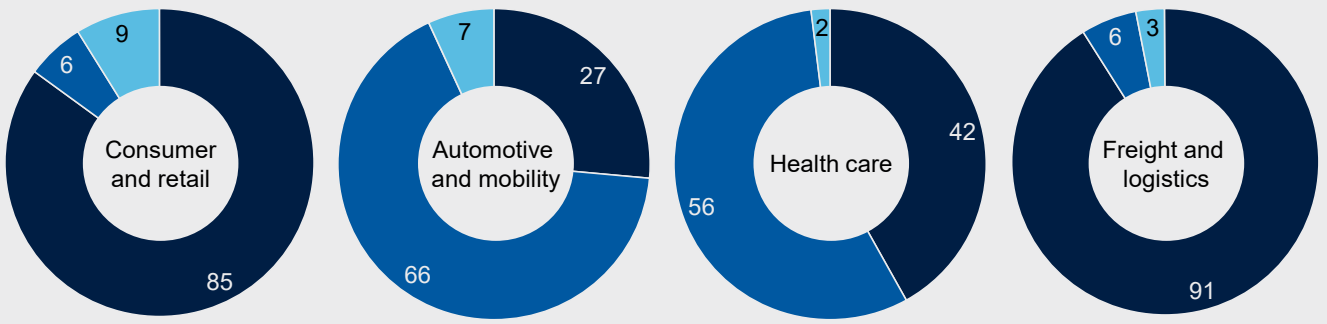
Our simulation finds that dematerialization has a relatively small impact compared with the other two digital forces. Although this has been a major disruptive force in the entertainment and content industry, where it drove the first wave of digital disruption, it is unlikely to have commensurate impact in manufacturing and other service industries because it is technically difficult—or even impossible—to replace physical products and services with digital offerings on a massive scale. A great deal of hype surrounds next-generation technologies such as VR, AR, and 3-D printing. However, we find that the biggest impact of these technologies is likely to be companies using them to make their business operations more efficient. In this report, we largely focus on dematerialization of goods, but we acknowledge that many services can also be dematerialized as supply chains digitize.

Exhibit 14

Disintermediation and disaggregation are the major forces in value-chain restructuring

HIGH SCENARIO

Value shift patterns
% of total digital disruption



SOURCE: McKinsey Global Institute analysis

CONSUMER AND RETAIL: A NEW DIGITALLY ENABLED EXPERIENCE

© Shanghaiface/Getty Images

The consumer and retail sector was one of the earliest sectors to digitize in China, which has become a global leader in e-commerce.[114] From less than 1 percent of the value of worldwide transactions only about a decade ago, the country's share is now more than 40 percent. The value of China's e-commerce transactions is today estimated to be larger than the value of those of France, Germany, Japan, the United Kingdom, and the United States combined.

The remarkable adoption of e-commerce by consumers reflects the fact that digital business models were successful in addressing widespread inefficiencies and fragmentation in traditional offline retail. Consider that the top five retailers in China account for a 2 to 20 percent market share in consumer electronics, health and beauty, and home and garden, compared with between 30 and 70 percent in the United States. Retail distribution is very complicated and inefficient. There are thousands of small multitier distributors with varying capabilities, which has long raised issues such as unauthorized distribution, counterfeit goods, and tax evasion, all of which jeopardize the consumer experience as well as the ability of manufacturers to protect the quality (and perceived quality) of their brands. Consumers, especially those living in smaller and medium-sized cities and in rural areas, have had limited choice in what they can buy.

Yet demand for products and services—and their quality—is rising as incomes increase and China's middle class expands. According to the 2016 McKinsey China Consumer Report, Chinese consumers are shifting to premium and are increasingly looking for healthy-living choices.[115] This combination of market inefficiencies and rising and evolving consumer demand offers significant opportunities for growth for consumer and retail companies. Those that adopt digital technologies are better able to offer innovative products and services that will enable them to meet consumers' demands and thrive in a competitive market.

The adoption of digital has simultaneous benefits for consumers, companies, and the economy.

- **Consumers.** Digital technologies can give consumers more choice and improved shopping experiences, creating significant consumer surplus. In the typical offline hypermarket, consumers have access to 20,000 to 50,000 stock-keeping units on average.[116] Meanwhile, China's e-commerce platforms list billions of items. Digital platforms also provide much higher levels of convenience than offline retailing, including a wide range of choices and personalized recommendations. Because online platforms offer significant "free" services such as search, messaging, and communications, and competition among these platforms is intense, consumers benefit from lower prices.

- **Consumer and retail companies.** Digital technologies can boost companies' top-line growth by giving them better access to new consumers in new markets. Digital solutions, such as analytics that enable personalized recommendations and omnichannel approaches that offer customers an integrated shopping experience, can generate incremental sales by minimizing the stages involved in consumer decisions. Moving toward new digital business models such as O2O and partnering with new digital players can give companies access to massive amounts of data that enhance their understanding of the market. Digital solutions also raise the efficiency of business

[114] For the consumer sector, we analyzed consumer-goods categories such as food and beverages, apparel, consumer electronics, and personal care. For retail, we analyzed online and offline retailers such as supermarkets, hypermarkets, and department and convenience stores (excluding automotive retail).

[115] *2016 China consumer report: The modernization of the Chinese consumer*, McKinsey & Company, March 2016.

[116] Data from the China Chain Store & Franchise Association show 20,000 to 50,000 stock-keeping units for hypermarkets, 5,000 to 20,000 for supermarkets, and 1,000 to 5,000 for convenience stores.

operations, and therefore lower costs. Partnership with e-commerce platforms can avoid huge upfront capital investment in physical stores and warehouse operations.

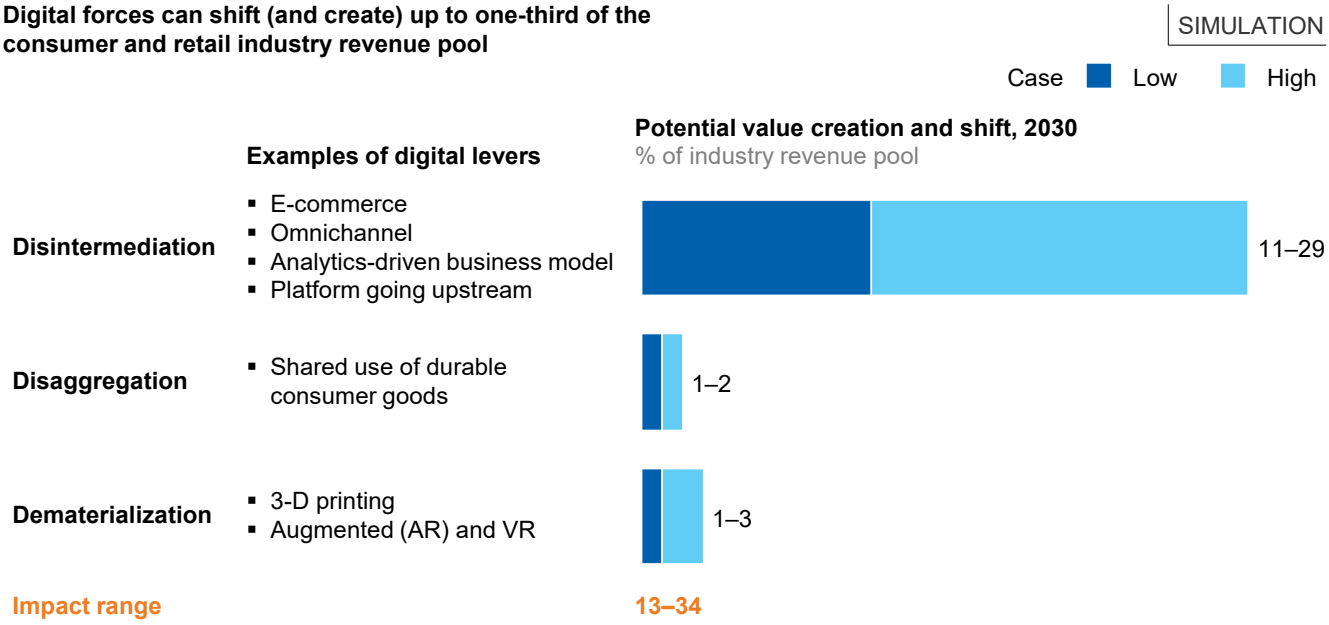
- **The economy.** Enabling more consumers to gain access to the products and services they want using digital means, and stimulating additional consumption because prices are attractive and offerings are superior, would make a significant contribution to China's stated aspiration to shift the entire economy from an export-driven industrial growth model to one that is driven by consumers.[117] Mindful of the pivotal role that digital can play in facilitating this shift, the Internet Plus initiative is part of the government's plan to double e-commerce transaction volumes to ten trillion renminbi ($1.5 trillion) by 2020, enabled by big data, cloud computing, block chain, AI, and precision marketing.[118]

BY RESTRUCTURING VALUE CHAINS, DIGITIZATION CAN SHIFT (AND CREATE) UP TO ONE-THIRD OF CONSUMER AND RETAIL REVENUE POOL

Our simulation finds that digitization can shift, and create, value in the order of 13 to 34 percent of the industry's revenue pool (Exhibit 15).[119] The major force in shifting and creating value is disintermediation at 11 to 29 percent of industry revenue. The impact of dematerialization and disaggregation is relatively small, at a combined 2 to 5 percent of revenue.

Exhibit 15

Digital forces can shift (and create) up to one-third of the consumer and retail industry revenue pool



NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

To understand how value can shift (or be created) by the three digital forces, we mapped and summarized 115 cases of use in relevant consumer and retail subsectors. In the case of disintermediation, we looked at different degrees of disruption as an increasing volume of e-commerce shifts to platforms that are moving upstream, thereby intensifying competition among online and offline retailers, and even among consumer-goods manufacturers. On

[117] See *China's choice: Capturing the $5 trillion productivity opportunity*, McKinsey Global Institute, June 2016.

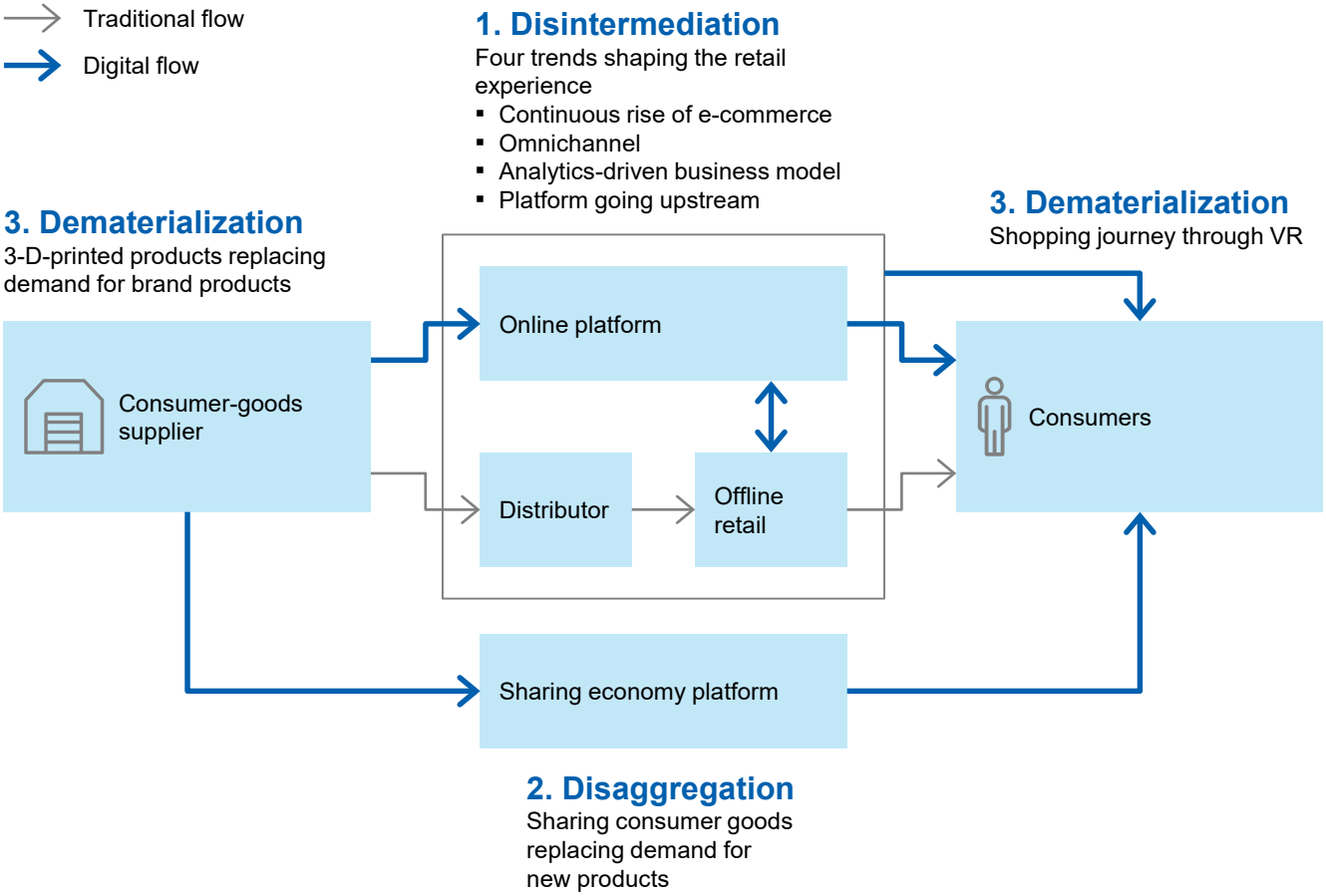
[118] Ministry of Commerce, China (http://images.mofcom.gov.cn/dzsws/201612/20161229191628547.pdf).

[119] The percentages are to gauge the size of value shift (or creation) relative to an industry's revenue pool. Given that there is overlap between consumer goods and retail sales figures, we used retail industry sales as the industry revenue pool.

disaggregation, we focused on key consumer-goods segments to assess how the sharing economy can reduce consumer demand. For dematerialization, we looked, in particular, at how VR, AR, and 3-D printing can trigger additional demand for products or services and can cannibalize existing high-value consumer products such as consumer electronics, eventually reducing the role of retailers (Exhibit 16).

Exhibit 16

Three digital forces can restructure the consumer and retail value chain



SOURCE: McKinsey Global Institute analysis

Disintermediation is by far the most powerful source of disruption to consumer and retail value chains

Disintermediation is the most powerful disruptive force in retail and will increasingly drive value away from offline retailers toward online players. We have focused on four major trends that will contribute to disintermediation in this sector: the rise of e-commerce, the omnichannel experience, analytics-driven business models, and platforms going upstream.

Trend 1. The (continuous) rise of e-commerce

A first wave of disintermediation occurred as e-commerce took off and spread across China. Simply by making products and services available online rather than only offline, e-commerce companies were able to capture rapid growth. China's e-commerce grew by 100 percent a year between 2003 and 2009 before gradually slowing down to (still robust) annual growth of around 45 percent between 2010 and 2016, according to iResearch. The pace of penetration of e-commerce has been much faster in China than, for instance, in Germany and the United States.

The growth of e-commerce is likely to continue because China still has relatively underserved markets. Penetration has been highest in China's largest (Tier 1) cities such as Beijing, Shanghai, and Shenzhen, at 75 to 85 percent. Penetration in Tier 3 and Tier 4 cities has been 55 to 60 percent—and in rural areas has been just 40 percent.[120]

As penetration of e-commerce into smaller cities and rural areas increases, this could stimulate new demand. Leading players are already building market share by expanding services in and developing new models for e-commerce in rural areas. Alibaba and JD.com (also known as Jing Dong) started expanding into rural areas in 2014. In their early stages, these efforts were highly labor-intensive, but digital technology has recently begun to reshape the way rural e-commerce serves customers. JD.com is developing drone-based delivery. It aims to have 100 routes by the end of 2017 and to become the first Chinese e-commerce player to roll out large-scale delivery via drones.[121]

~20%
of all foreign trade was cross-border e-commerce in 2016

Cross-border e-commerce is starting to gain prominence. The value of total cross-border e-commerce transactions reached about 6.3 trillion renminbi ($1 trillion) in 2016, about 20 percent of all foreign trade, according to China's Ministry of Commerce. A recent PayPal report estimated that 35 percent of Chinese online shoppers bought cross-border products in 2015, compared with 26 percent in 2014. We expect this trend to continue as China's growing army of middle-class consumers seeks out imported products and services online.[122] The Chinese government has explicitly encouraged cross-border e-commerce as part of its broader strategy of moving the economy toward consumption-based growth. In 2014, the government designated seven cities—Chongqing, Guangzhou, Hangzhou, Ningbo, Shanghai, Shenzhen, and Zhengzhou—as e-commerce pilot zones. According to China's Ministry of Commerce, the country currently has more than 5,000 cross-border e-commerce platforms.

Trend 2. The omnichannel experience

The path to purchase of a good or service is changing and becoming far more complex. In the first stage of the development of e-commerce, companies such as eBay and Taobao focused on pure customer-to-customer platform plays. In the second phase, business-to-consumer (B2C) platforms such as Tmall, JD.com, and VIP.com appeared. In the third phase now unfolding, the typical consumer journey is likely to be a mix of offline and online, or omnichannel. As the traditional e-commerce business model becomes commoditized, digital attackers also have an incentive to experiment with new retail models.

To understand how omnichannel e-commerce is shaping retail, we assessed how Chinese consumers' decision journeys are changing. According to the McKinsey China iConsumer Survey 2017, only 11 percent of respondents consumed exclusively offline. At the same time, however, only 4 percent were pure online consumers. A huge majority of shoppers in China—85 percent—are omnichannel consumers. Consumer goods and retail companies need to take this into account if they are to retain their existing customers and maximize their potential (Exhibit 17).[123]

[120] McKinsey iConsumer Survey 2017. The city tiers largely reflect a combination of GDP and population. There are four Tier 1 cities, defined as having populations of more than five million and GDP of more than 1 trillion renminbi ($151 billion). There are 46 Tier 2 cities, with populations of more than five million but GDP of more than 135 billion renminbi ($20.3 billion). There are 193 Tier 3 cities and 696 Tier 4 cities, which have populations of more than 2.6 million and lower GDP and per capita GDP than Tier 1 and 2 cities.

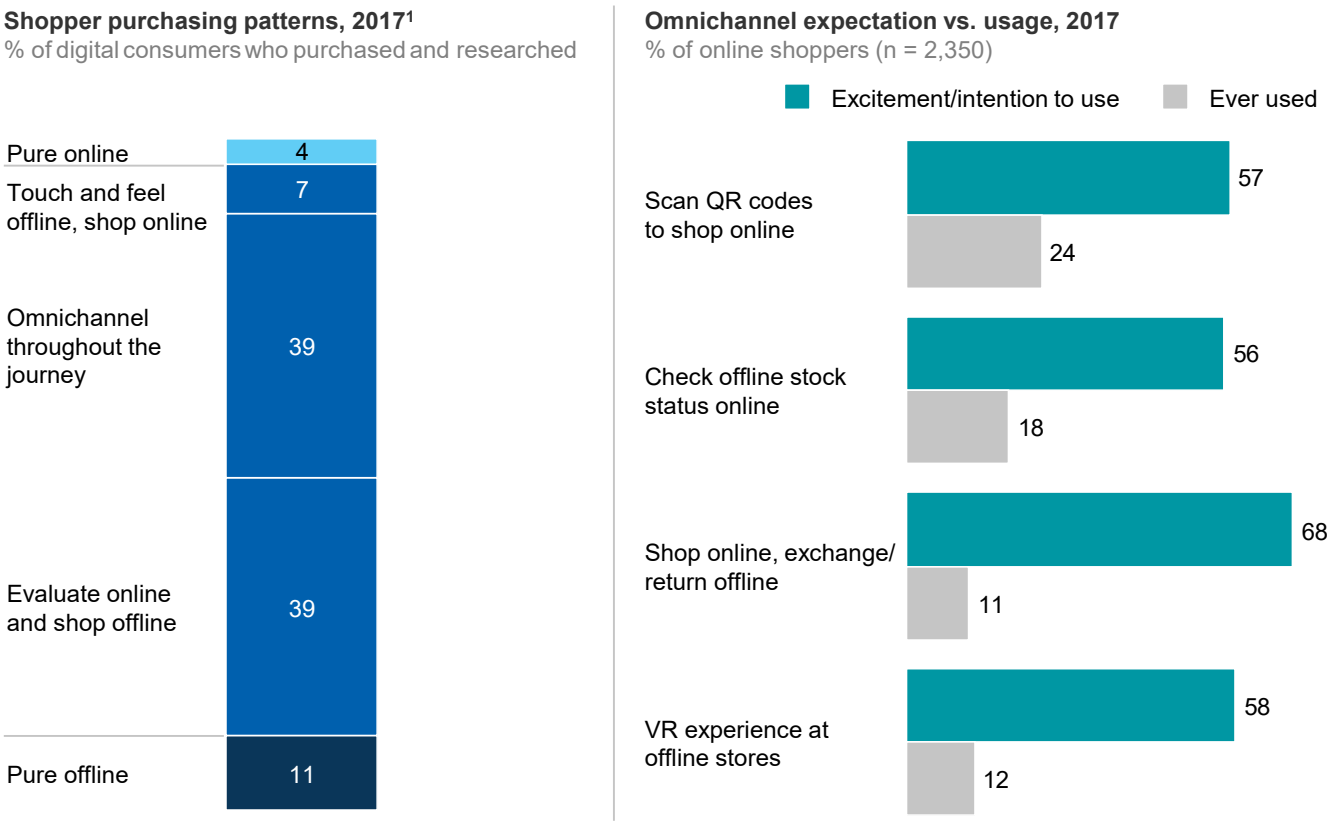
[121] *Drone delivery program*, JD.com fact sheet, November 2016.

[122] Chenan Xia, "Cross-border e-commerce is luring Chinese shoppers," *McKinsey Quarterly*, February 2016.

[123] Kevin Wei Wang, Lambert Bu, Nianling Liao, and Lei Xu, *Redefining customer experiences for China's new retail era*, China iConsumer Research 2017, June 2017. The survey reported in this research covered more than 5,900 respondents across a wide range of age groups, household income levels, internet usage patterns, and tier cities in China, coupled with in-depth interviews and workshops.

Exhibit 17

Eighty-five percent of Chinese shoppers have already adopted omnichannel, and their expectations of the experience are rising



1 Weighted average of five key product categories, including consumer electronics.
NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey iConsumer China Survey 2017; McKinsey Global Institute analysis

There are three major groups of omnichannel shoppers. The first group—39 percent of respondents—evaluates products online using social media and recommendation sites and buys offline. These consumers often find comparisons and detailed product information online, and then go to offline stores to check physical products, interact with salespeople, and complete their transaction if they find an attractive deal. The second-largest group, 39 percent of respondents, is omnichannel throughout the purchasing journey. This group shifts constantly between online and offline channels, the pattern often varying depending on the characteristics of the products and personal preferences. The third group, accounting for 7 percent of respondents to the iConsumer survey, "touch and feel offline and shop online"—they prefer to look at and compare physical products, and then go online to buy.

It is important to note that for all three groups, offline remains important even if its role is changing. Broadly, offline is shifting from being a primary sales channel to a shopping "experience." In the consumer-electronics category, shoppers who performed online research while visiting a retail outlet bought the same brand they originally had in mind more than 80 percent of the time. This means that brand and retail companies need to pay close attention to shaping the omnichannel experience. There is a great deal of room to experiment and improve. About 60 to 70 percent of shoppers surveyed said that they were excited about omnichannel services such as O2O product pickup, QR code-scan payments, product-return services, and VR experiences at offline stores. Nevertheless, only 10 to 25 percent of shoppers surveyed said that they had actually used these offerings.

Digital attackers are increasingly adopting omnichannel approaches. In the United States, Amazon made its name in e-commerce and is now supplementing its core online business with a physical presence. It rolled out its first offline bookstores and Amazon Fresh in 2015 and its high-tech Amazon Go grocery store in 2016; in 2017, it paid $14 billion for Whole Foods, which has more than 450 stores throughout the United States.[124] Traditionally, grocery retailing has been a tough business due to thin margins, high fixed costs, and the challenges of dealing with perishable products with different handling and temperature requirements. But Amazon is making full use of technology to automate its offline business and overcome such issues. Amazon Go, for instance, has shelf-stacking and store-cleaning robots.[125] In its bookstores, Amazon stocks a relatively small inventory because everything else can be ordered online, and it devotes a great deal of shelf space to e-readers and streaming TV devices.[126] Offline retailers are fighting back by moving in the opposite direction. For instance, Wal-Mart has acquired several online companies in apparel and footwear in order to compete. [127]

The same trends are apparent in China. In mid-2017, Alibaba opened three Hema supermarkets in Beijing and Shanghai. Although these are physical stores, they offer an omnichannel experience. Customers shop, eat, and order groceries for delivery using their mobile phones (and pay using Alipay). Every item in the store has a barcode so that customers can obtain information. Results thus far suggest that these stores are popular. Sales are between three and five times higher than those of a traditional supermarket; the conversion rate for consumers using the brand's app is high at 35 percent; and online orders still account for more than half of all sales.[128] Alibaba has also formed partnerships with offline retailers, including Suning, Parkson, and Lianhua Supermarket. JD.com formed a partnership with Wal-Mart to further integrate their platforms, supply chains, and customer resources in China, and JD.com intends to open more than one million convenience stores across China over the next five years.[129] Established offline retailers are moving online, too. Rainbow Mall, a Shenzhen retailer, launched Tian Hong Jin, which caters not only to online shoppers but also to offline visitors, who can search for a parking space and use self-checkout. The store also has different themes for different target customers, such as "delight of life" for middle-class shoppers and "COOL+" for millennials.[130]

O2O commerce—a category that embraces on-demand services, daily deal sites, and click-and-collect services offered by traditional offline retailers—is becoming an important form of omnichannel. In China, O2O also covers services such as picking up dry cleaning, home haircuts, and the delivery of fresh produce. iResearch, whose definition of O2O focuses on local services that include medical care and dining, estimates that O2O sales of services in China increased by 38 percent in 2015 to 335 billion renminbi ($51 billion) and was expected to grow at a rate of 20 percent a year to 2018 to reach 626 billion renminbi ($94 billion).[131] O2O enables consumer and retail companies to maximize their selling potential by using "scenario-based shopping"—solutions that facilitate a smooth transition from daily life scenarios to retailing that help to capture demand.

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[124] Conor Sen, "Wal-mart looks at online presence, Amazon considers offline stores," ETRetail, April 19, 2017; Leslie Hook, "Amazon's drive-in grocery store marks new offline push," *Financial Times*, November 29, 2016; and John Wasik, "Amazon's real agenda behind Whole Foods bid," *Forbes*, June 21, 2017.

[125] *The future of grocery—in store and online*, McKinsey & Company podcast, June 2017.

[126] "5 reasons why Amazon is experimenting with physical stores," *Fortune*, April 28, 2017.

[127] For more on omnichannel in grocery, see Ralf W. Seifert and Richard Markoff, *Amazon Fresh and the disruption of the supply chain: Disruption is not always what it seems*, IMD, June 2017; Ralf W. Seifert and Richard Markoff, *Amazon buys Whole Foods—a grocery revolution?* IMD, June 2017; and Bill Taylor, "Amazon, Whole Foods, and the future of the (old) new economy," *Harvard Business Review*, June 16, 2017.

[128] Adam Najberg, *Hema supermarket offers shoppers a new retail experience*, Alizila, July 17, 2017.

[129] See *Walmart and JD.com expand strategic cooperation*, JD.com press release. July 25, 2017; and Man-Chung Cheung, *China's ecommerce giants seek brick-and-mortar presence*, eMarketer, May 1, 2017.

[130] *Rainbow Mall: A mall being underestimated*, Sohu, May 22, 2017 (http://www.sohu.com/a/142528353_689309).

[131] *Understanding China's O2O commerce marketplace*, eMarketer, August 22, 2016.

Trend 3. Analytics-driven business models

Chinese consumers increasingly want to buy higher quality and customized products and services. With technology as an enabler, digital media, social networking, and search engines give content away, and therefore consumer-goods and retail companies can monetize much more consumer data, understand customers' behavior and sentiment in real time, and influence consumer decisions more than ever before.[132]

In China, data gathering takes place on a monumental scale. Superapp functionality makes it easier to microsegment customers and target their needs in a very detailed way, facilitating mass customization and personalization. The key challenge for consumer-facing and retail companies in China is how to mine this data effectively—without putting consumers off. Consumers are bombarded with online advertising and many feel overloaded with information, some of which they believe is inaccurate or irrelevant. In the McKinsey iConsumer Survey, 98 percent of social media users said that they had received advertising but only 18 percent of respondents said that advertisements were personalized for their preferences. Leading global players generate an estimated 30-plus percent of their revenue from such recommendations.[133]

Powerful analytics solutions can bring new products and services to consumers. One example is virtual assistance enabled by AI. Virtual assistants are being developed for homes to offer consumers convenience. "Smart" home assistants use computerized vision to identify goods that the consumer may want to buy or identify preference patterns using images and videos liked online. This technology has potential to disrupt traditional shopping. For instance, Amazon's Echo Look device, which was unveiled in April 2017, incorporates a camera into the Alexa device's virtual-assistant function and recommends styles based on the user's wardrobe and body shape, combining machine learning and computer vision.[134] In China, Alibaba offers its customers Tmall Genie, a smart speaker that is activated in Mandarin and can then be used to order items. Baidu and Tencent have made similar moves recently. These developments represent particular challenges for companies that depend on loyalty to brand names. When consumers order toilet paper, diapers, or razors, they may not specify a brand; this shifts the decision about which brand is sold from the owner of the brand to the organization managing the data and algorithms.

Analytics and digital connections with consumers are enabling the emergence of new customer-to-business solutions that engage customers directly and gather their data so that orders can be customized. LePur Yogurt, a premium Greek-style yogurt startup founded in 2014, has built an enthusiastic customer base by listening to their recommendations about product development, brands, packaging, and customer experience design through the WeChat app and the microblogging site Weibo. Another example is Red Collar, a Qingdao-based apparel maker specializing in men's suits. The company allows customers to make an appointment, and one of its "magic buses" comes to pick them up at their homes. Red Collar makes luxury garments in large quantities and is therefore able to sell at mass-market prices. The company says that it fulfills more than 3,000 custom orders a day using a "customer-to-manufacturer" data system.[135] Shangpinzhaipei, a Guangzhou-based furniture manufacturer, offers customized furniture to individual consumers by using big data and analytics. The company has built a database of different types of houses, rooms, products, and designs. Using data on customers' age, gender, and design preferences, the system

[132] *The age of analytics: Competing in a data-driven world*, McKinsey Global Institute and McKinsey Analytics, December 2016.

[133] *Big data: The next frontier for innovation, competition, and productivity*, McKinsey Global Institute, May 2011.

[134] *Artificial intelligence: The next digital frontier?* McKinsey Global Institute discussion paper, June 2017.

[135] Jane Ho, "China's suit maker Redcollar blazes trail for mass made-to-measure," *Forbes*, August 15, 2016.

automatically suggests options to consumers who are then able to tailor further; the data gathered during this process are then fed into the system for future use.[136]

Trend 4. Platforms going upstream

Observers have long been skeptical about online platforms moving beyond their core businesses and moving upstream, but this is now happening as the platforms seek to broaden their business and strengthen their relationships with consumers. Just as private labels are a huge market offline—accounting for 8 percent of retail sales in Singapore, 18 percent in the United States, and 21 percent in Australia, according to Nielsen—online players are creating their own content informed by the mass of data they gather about their customers.

The media sector has experienced a great deal of activity of this kind. Netflix, for instance, originally provided video-on-demand online and DVDs by mail. In 2013, it expanded into film and television production. The company has 100 million members and has generated content valued at $11 billion in mid-2017.[137] Similarly, Amazon has launched private labels since 2004, expanding from furniture and home goods to electronics accessories on AmazonBasics and fashion brands. In these categories, penetration is around 10 to 20 percent.[138]

Such strategies are not yet broadly in evidence in China, but it is possible that Chinese online platforms may move in the same direction as competitors in the United States and elsewhere. China's strong manufacturing ecosystem, which produces more than 25 percent of global manufacturing value added, might offer partnership opportunities for online platform companies to explore in a drive to move upstream.

How value might shift

Our simulation analysis suggests that the shift in value and value creation enabled by digital technologies is largely an opportunity for online platforms and broadly a threat to traditional offline players (Exhibit 18).

Online platforms can capture huge upside from all four types of disintermediation in consumer and retail. They have plenty of scope to continue to expand into smaller cities and rural areas. They are in a good position to embrace omnichannel strategies either through partnerships with offline players or by setting up their own offline sales outlets. They have much to gain from going deeper into innovative analytics-driven business models that can further shift advertising spending from traditional media to online retailers and platforms, and can create additional consumption fueled by the targeted information available from the gathering and analysis of data. And they can potentially go upstream to broaden their revenue streams.

Our simulation suggests that online platforms can capture value equivalent to between 11 and 20 percent of the industry's revenue pool in China. Some of this will be as the result of value being lost elsewhere—notably by offline retail players—but some will come from new value created by incremental consumption triggered by mass personalization, smart recommendations, and omnichannels. However, we cannot assume that this value will be captured exclusively by existing online players. Competition among established players is already intense, and new digitally enabled attackers can enter the fray at any time. In addition, incumbent retailers and brands could disrupt their own business models through digitization and become competitors, too.

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[136] *Shangpinzhaipei offers customized furniture to individual consumers by using big data and analytics*, JRJ, March 31, 2017 (http://biz.jrj.com.cn/2017/03/31170922252863.shtml).

[137] Tim Bradshaw and Shannon Bond, "Netflix looks to become world's entertainer as it hits milestone," *Financial Times*, July 20, 2017.

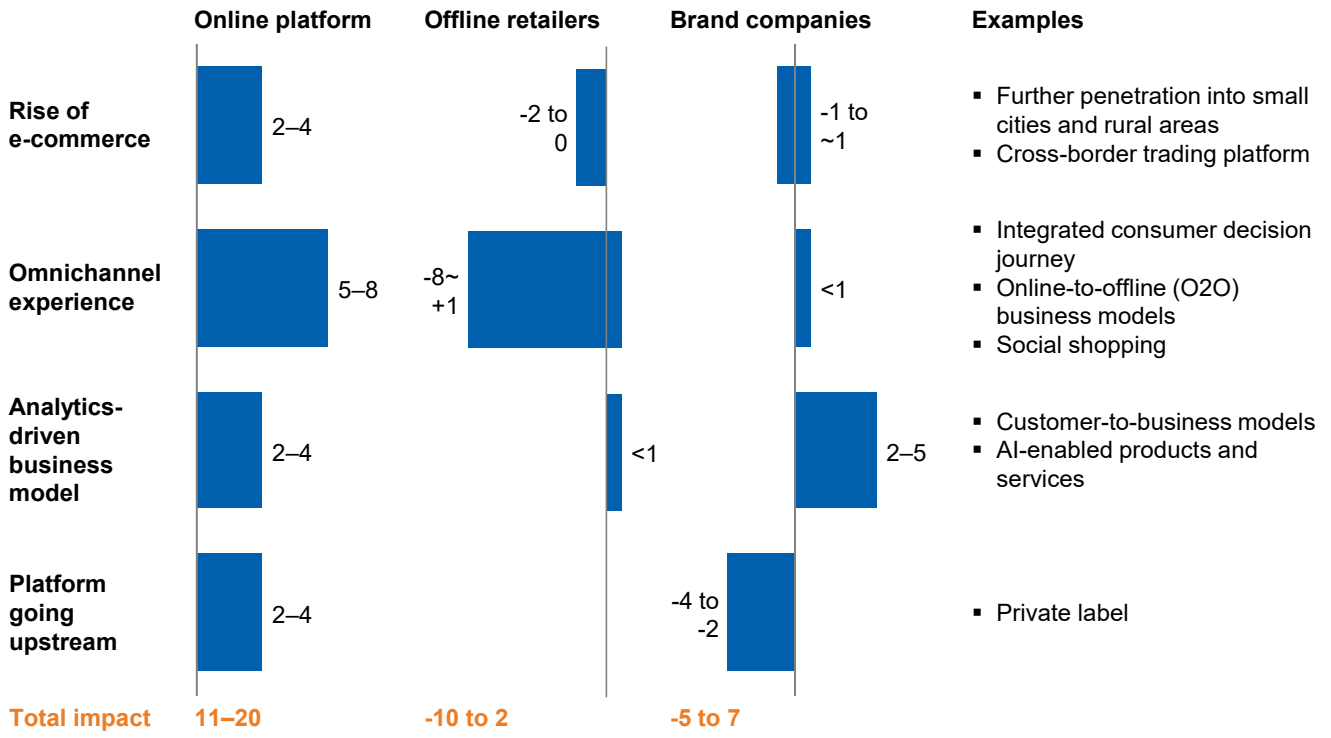
[138] Mary Meeker, *Internet trends 2016—Code Conference*, Kleiner Perkins Caufield Byers, June 1, 2016.

Exhibit 18

Disintermediation can increasingly shift value toward online platforms

SIMULATION

Potential value creation and shift
% of industry revenue pool



SOURCE: McKinsey Global Institute analysis

Digitally enabled disintermediation is largely a threat to offline businesses. The rising penetration of e-commerce, the increasing digitization of shopping, and the massive amount of data accumulated by online platforms mean that offline businesses could be in a self-reinforcing cycle of cannibalization that diminishes their role as both information and sales channels. There is large scope for their revenue to shift to online platforms. In the United States, where the online consumer and retail market is relatively mature, the threat to offline players is already evident. Bankruptcies among offline retailers are near the peak observed during the recession in 2008. According to one study, between 20 and 25 percent of US shopping malls might close over the next five years.[139]

Given that China is still a growing market, the situation may not be as difficult. In fact, online and offline transactions can grow at the same time. Nevertheless, some types of retailers are facing more challenges than others. According to Euromonitor, store-based retail space grew by 5 percent per year between 2011 and 2016, but growth is expected to slow to 2 percent a year between 2016 and 2021. Notably, retail space for traditional grocery retailers and department stores grew by 0.4 percent and 2.6 percent, respectively, from 2011 to 2016, much slower than the industry average. These two segments may display negative growth over the next five years.

Brand companies are encountering both opportunities and threats. In China, these companies have suffered because they have limited information on consumers and their

[139] Christian Buss et al., *Apparel retail & brands: Making sense of softlines following a tumultuous twelve months*, Credit Suisse, May 2017.

preferences, but digital channels give them the opportunity to develop much greater transparency about sales data and consumer relationships. They can use digital channels to reach consumers directly, understand them better, and tailor product development and marketing. Nevertheless, online platforms continue to generate far more data and have already established direct relationships with millions of Chinese consumers; they can be formidable partners and competitors to brand companies.

Disaggregation can have an impact in niche categories

Disaggregation in consumer and retail includes the sharing and renting of goods and services. Some sharing-economy models—including ride-sharing and short-term real estate rental—are well established worldwide, including in China, but these models are expanding to include such items as fashion, toys, luggage, batteries, and umbrellas (although there have been operational challenges with some product categories).

To estimate the overall potential for disaggregation in consumer goods, we assessed 50 product categories and examined their market vulnerability based on four factors: high product value; low level of utilization; high durability and reusability; and high predictability of demand. Products that have all four factors are most amenable to innovative business models and interconnected platforms. Our analysis finds that more than ten subsectors including fashion, portable accessories, and luxury goods have high potential for disruption through disaggregation, but this process is still at an early stage in China.

The sharing of fashion and luxury apparel is emerging around the world, especially in large cities. In the United States, Seattle-based Bag Borrow or Steal is an online rented-luxury retailer, offering designer handbags, jewelry, sunglasses, watches, and luggage. New York-based Rent the Runway, founded by two Harvard Business School graduates and described by *The New York Times* as a "Netflix model for haute couture," is an online service providing rentals of designer dresses and accessories.

Fashion rental—or sharing—is also big business in large cities in India. Flyrobe and Swishlist, Mumbai, have been growing rapidly. Flyrobe served 300 orders in November 2015 and 1,600 in February 2016. Launched in September 2015, Swishlist has been growing at 100 percent a month.[140] Fashion rental has come to China, too, with Beijing-based YCloset now operating in around 40 cities. Shanghai-based Ms Paris and Dora's Dream in Chengdu are two other examples.[141]

In other product categories that do not share all four factors, players are experimenting with business models. Portable battery chargers are just one of many new sharing-economy ventures that have emerged in China recently. Umbrella sharing is another example. Molisan rents umbrellas to Shanghai commuters through vending machines for one yuan ($0.15) for 12 hours. Meanwhile, Zhu Le Ge Qiu, a startup in Zhejiang Province, hopes to rent basketballs in more than 80 percent of China's indoor stadiums.[142] Many other products are possibilities for the sharing model, including furniture, copiers, washing machines, wardrobes, massage chairs, televisions, and smartphones. It remains to be seen whether the excitement about the potential of sharing turns out to be overhyped because the business model is not sustainable (risk of theft and concern about hygiene, for example, could stand in the way) or whether these models continue to expand. Over a 40-day period in early 2017, businesses providing portable battery chargers for sharing raised nearly

[140] Sravanthi Challapalli, "The mojo of renting," Hindu BusinessLine, March 17, 2016.
[141] Pan Yue, "IDG joins $20m round in Chinese women clothing rental firm YCloset," China Money Network, March 20, 2017.
[142] Zhang Ye, "China's sharing economy startups vault into variety of ventures," *Global Times*, May 14, 2017.

1.2 billion yuan ($180 million), almost five times the amount raised by the bike-sharing industry in 2015.[143]

How value might shift

If the shared-business model develops further across a range of consumer products, this may reduce demand for new products. However, our current simulation suggests that industry-wide adoption is likely to be relatively limited, and that this model may not become mainstream in China because the number of categories that meet all four prerequisites—high value, highly durable, highly predictable, and low utilization—is small.

Dematerialization can offer convenient and customized solutions but is still at an early stage of development

VR, AR, and 3-D printing solutions can reinforce the trend of dematerialization in consumer goods and the retail sector more broadly, but the impact on value chains could be more limited than current enthusiasm among observers suggests.

Some major Chinese players are in the initial stages of experimenting with these ideas. For instance, Alibaba's Buy+ virtual cross-border shopping experience, showcased for the first time at the 2016 Singles Day Festival, enabled shoppers to put on a VR headset, instantly move to New York City, be greeted by salespeople at Macy's, and pay using Alipay. However, there is debate about how far VR and AR will penetrate, and whether digital solutions may eventually replace physical products altogether. For instance, in an extreme case, consumers may watch television using a small VR device instead of buying a large appliance and putting it in their living rooms. Small, connected VR devices could replace smartphones or entertainment experiences in theme parks, potentially reducing incumbents' revenue streams.

Dematerialization of design, production, and distribution through 3-D printing technology is also still in its early stages. We assessed the vulnerability to this technology of 50 consumer good product categories based on five key factors: ease of using 3-D printing; room to shorten time to market; potential demand for customization; special functionality that can be 3-D printed; and cost efficiency. We found that 14 subsectors, including footwear, jewelry, home furnishing, and toys, have the most potential to be 3-D printed. For example, in footwear, 3-D printing can tailor shoes to an individual's foot, overcoming current sizing limitations (only half-integer measurements) and offering non-standard widths. In 3-D printing of shoes, the system uses photographs of a customer's foot from all angles combined with detail about his or her height, weight, and activities. Using these data, the printer produces a shoe precisely fitting the customer. Companies such as Feetz print shoes and ship them to customers; others, like United Nude, print shoes in a store in front of the customer.[144]

Incumbents can also use the technology. For example, Silicon Valley startup Carbon has partnered with Adidas to mass produce 3-D–printed shoes.[145] Zaiwu, motivated by Chinese millennials' strong consumption power, is experimenting with a 3-D printing business model. It has built a network of designers and 3-D printing service providers. Designers can upload various types of product onto the company's website, and consumers can customize their order by choosing the style and material; the order is then submitted to a 3-D printing shop, produced, and delivered. The company's current focus is on household items and accessories.

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[143] "Sharing battery start-ups raised 1.2 billion within 40 days," Xinhua News, May 24, 2017 (http://news.xinhuanet.com/yuqing/2017-05/24/c_129614944.htm).

[144] Daniel Burrus, "3D printed shoes: A step in the right direction," Wired, September 2014.

[145] Emma Thomasson and Aleksandra Michalska, "Adidas to mass-produce 3D-printed shoe with Silicon Valley start-up," Reuters, April 7, 2017.

How value might shift

For consumer-goods companies, dematerialization is both an opportunity and a threat. In certain discrete categories, there could be a shift in value from traditional players to attackers using new technologies. New digital companies can use VR and AR technologies to capture demand from offline retailers and current e-commerce players; fashion companies using 3-D printing for mass customization and theme-park players using VR are two examples. However, incumbent companies can also use these technologies to improve their value proposition. For instance, VR and AR can enhance the omnichannel experience they offer their customers.

Nevertheless, the question remains whether there will be sufficient demand for these technologies to take off. Chinese companies use 3-D printing largely for industrial purposes. The use of 3-D to directly serve consumers in sectors such as fashion, household products, and toys is not well developed. Our simulation suggests that without a clear signal of consumer demand for 3-D–printed consumer goods, as well as technological advances that enable the printing of customized products cheaply and rapidly enough to be attractive to consumers, this solution is likely to be confined to serving niche customers willing to pay premium prices for customized design.[146] Production time today is typically several hours per product, making it difficult to scale up and mass customize.

WHETHER AND WHEN DISRUPTION WILL OCCUR DEPENDS ON A NUMBER OF FACTORS

All of the forms of disruption that we have discussed have the potential to happen, but it is difficult to predict whether they will, to what degree, and when. Companies can watch out for several factors in attempting to make a judgment.

- **Will the technology be advanced enough to offer commercially viable solutions?** In the case of advanced analytics and big data, raw data need to go through several steps, including generation and collection, aggregation, and analysis, before they can be used for insights that drive business decisions. Although China's BAT companies have superapps, incumbent consumer-goods and retail manufacturers still struggle to connect their data and consumers' personal information with big data received from business partners in a structured and seamless way. This is an important technical barrier to resolve.[147] We don't yet know whether 3-D printing can substantially improve its speed and lower its costs sufficiently to drive further penetration, or whether 3-D technology will advance sufficiently to print consumer goods.

- **Will consumers embrace new digital business models?** Interestingly, one five-country study indicated that Chinese consumers are less concerned about companies using their personal data to market to them than consumers in other countries.[148] This could potentially be good news for the development of big data analytics in retail, and for Chinese companies designing products and services using personal data. In the case of consumer adoption of the sharing economy, there are doubts about how willing Chinese citizens are to embrace this model because of trust and risk issues. In the case of toys, Chinese consumers may worry about sharing because of hygiene issues. Umbrella sharing has faced operational challenges because of theft. Weeks after setting up umbrella sharing in 11 cities across China, Sharing E Umbrella said that it had lost

[146] Daniel Cohen, Matthew Sargeant, and Ken Somers, "3-D printing takes shape," *McKinsey Quarterly*, January 2014.

[147] *The age of analytics: Competing in a data-driven world*, McKinsey Global Institute and McKinsey Analytics, December 2016.

[148] Timothy Morey, Theodore Forbath, and Allison Schoop, "Customer data: Designing for transparency and trust," *Harvard Business Review*, May 2015. Also see Timothy Morey and Rainer Wessler, *Designing with data in China: Opportunity and risk*, Design Mind, February 28, 2013.

almost all of its 300,000 umbrellas.[149] However, in the past, observers argued that online shopping would not take off in China because consumers did not trust sellers on the internet; that was resolved by digital payments and consumer-protection programs. Trust issues around the sharing economy may similarly dissipate if a combination of business solutions and regulation is in place to prevent abuses.

- **Will the regulatory framework support the development of new business models?** As parts of the digital sector mature, regulators are becoming more active, and they could influence the speed at which disruption is likely to happen. The power of analytics-driven business models can be unleashed only when there is a suitable regulatory framework that balances consumer privacy and business opportunities from collecting and monetizing data. The sharing-economy business model for consumer products involves risks of theft and fraud, and therefore effective supervision, consumer protection, and enforcement are necessary if this model is to gain traction.

[149] *Umbrella-sharing startup loses nearly all of its 300,000 umbrellas in a matter of weeks*, Shanghaiist, July 10, 2017.

AUTOMOTIVE AND MOBILITY: TRANSFORMING THE FUTURE OF TRANSPORTATION

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~30%
of the global passenger car merket is in China

China's passenger car market became the largest in the world by sales when it overtook the US car market in 2010. In that year, Chinese consumers bought 11.6 million new vehicles, 1.9 million more than US buyers.[150] By 2016, China's automotive sector accounted for about 30 percent of the global passenger-car market. However, the blistering pace of growth is slowing, margins achieved by car companies are tightening, and the sector faces challenges from broader economic and social issues, including urban traffic congestion, air pollution, and relatively poor road safety.

Digital technologies offer potential new commercial opportunities at the same time that they address existing issues. McKinsey has estimated that the revenue pool of the automotive industry could increase by about 30 percent—or $1.5 trillion—by 2030 as a result of connectivity services, shared mobility, and feature upgrades globally.[151] Consumers, companies, and the economy more broadly can benefit.

- **Consumers.** Digital solutions can save consumers time and money. People living in large cities, in particular, spend more time traveling to and from work because of severe traffic congestion, which undermines their productivity. In 2013, the capital's average daily congestion time totaled one hour and 55 minutes, 25 minutes longer than in 2012, according to Beijing's Department of Transportation.[152] Another source of unnecessary cost is serious underutilization of cars, which are parked 95 percent of the time on average, according to a survey by J.D. Power.

- **Automotive companies.** As the Chinese automotive market matures, its growth rate is slowing, and margins are deteriorating.[153] The average sales price domestic OEMs received fell by 13 percent between 2012 and 2016—good news for consumers, but a potential problem for automotive companies.[154] In this context, the digitization of vehicles offers welcome new opportunities in product development, including connected electric vehicles, digital hardware such as sensors and chips, and connectivity solutions such as autonomous driving and remote maintenance. Automotive companies can also improve their own efficiency through digital procurement and smart manufacturing. Digital solutions enable automotive companies to have direct relationships with their customers, get to know their preferences, target them with tailored products, and thereby solidify relationships and maximize the lifetime value of customers.

- **The economy.** Digital solutions can mitigate urban traffic congestion, which costs China an estimated 5,000 renminbi to 9,000 renminbi ($750 to $1,355) in lost productivity per capita in large cities, according to one study.[155] A survey conducted in 2014 by Peking University's National Development Research Institute put the cost of congestion to Beijing alone at 70 billion yuan ($11.3 billion); 80 percent of that loss related to time wasted, 10 percent to extra fuel consumption, and 10 percent to environmental damage.[156] Digital technologies can also help to address air pollution; the World Health Organization (WHO) reports that exposure to PM2.5 and PM10 (particulate matter) causes more deaths per year in China than in any other country in the world—more than

[150] Global Insight.

[151] For a broad perspective on trends in the automotive industry, see *Automotive revolution—perspective towards 2030: How the convergence of disruptive technology-driven trends could transform the auto industry*, McKinsey & Company Advanced Industries, January 2016.

[152] "Traffic jams cost Beijing $11.3b a year," *China Daily*, September 29, 2014.

[153] Returns to China's OEMs have started to decline as they expand dealership networks aggressively to increase sales and market share. However, despite the fact that the number of dealerships almost doubled between 2008 and 2013, margins are less than 2 percent for some of the top Chinese automotive dealer networks. See *Innovating automotive retail: Journey towards a customer-centric, multiformat sales and service network*, McKinsey & Company Advanced Industries, 2014.

[154] China Auto Index Corporation.

[155] *2016 Intelligent mobility big data report*, CBNData, January 12, 2017 (http://www.cbndata.com/report/93).

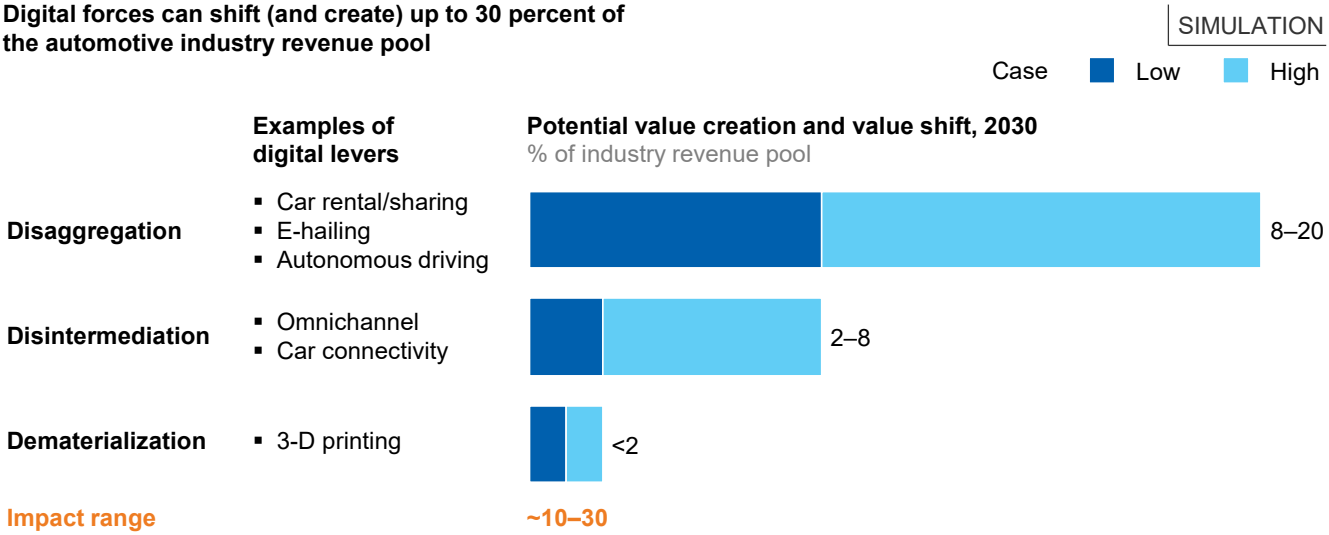
[156] "Traffic jams cost Beijing $11.3b a year," *China Daily*, September 29, 2014.

one million people, or 76 deaths for every 100,000 people.[157] Digital "smart" mobility solutions can reduce the number of fatalities from traffic accidents.

Our analysis finds that digitization can shift and create value equivalent to between 10 and 30 percent of the automotive industry revenue pool, primarily through the adoption of shared mobility, omnichannel approaches, and connected cars (Exhibit 19).

Exhibit 19

Digital forces can shift (and create) up to 30 percent of the automotive industry revenue pool



NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

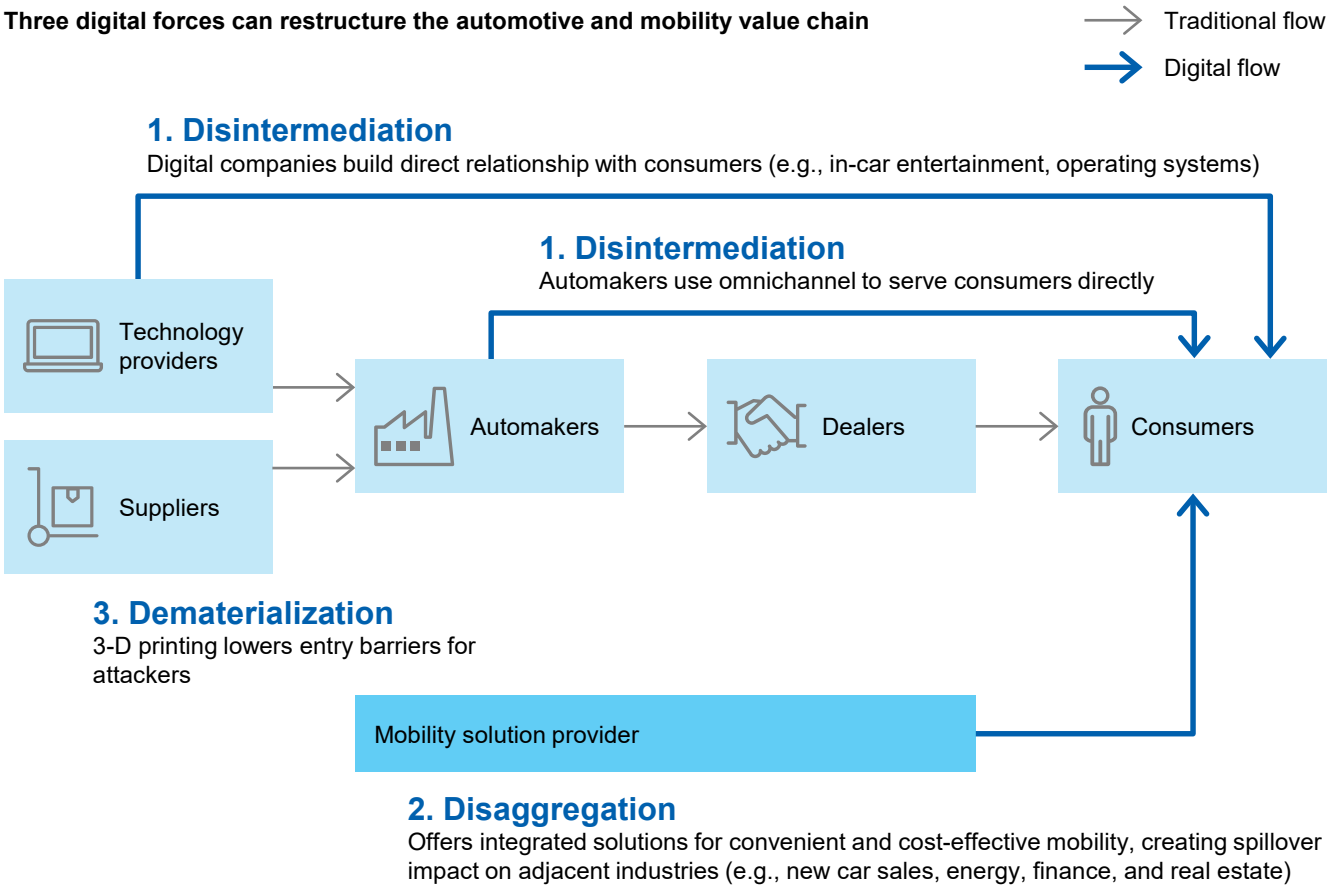
BY RESTRUCTURING VALUE CHAINS, DIGITIZATION CAN SHIFT (AND CREATE) UP TO 30 PERCENT OF THE AUTO REVENUE POOL

We analyzed around 55 use cases in the automotive and mobility sector. This analysis reveals that two types of disintermediation (omnichannel and car connectivity) and two forms of disaggregation (car sharing and e-hailing) are likely to have the largest impact. We estimate that dematerialization such as 3-D printing will have a much smaller effect. We chose to focus on omnichannel and connected cars, both types of disintermediation, and shared mobility (Exhibit 20).

[157] Adam Vaughan, "China tops WHO list for deadly outdoor pollution," *The Guardian*, September 27, 2016.

Exhibit 20

Three digital forces can restructure the automotive and mobility value chain


Traditional flow
Digital flow
1. Disintermediation
Digital companies build direct relationship with consumers (e.g., in-car entertainment, operating systems)
1. Disintermediation
Automakers use omnichannel to serve consumers directly
Technology providers
Suppliers
Automakers
Dealers
Consumers
3. Dematerialization
3-D printing lowers entry barriers for attackers
Mobility solution provider
2. Disaggregation
Offers integrated solutions for convenient and cost-effective mobility, creating spillover impact on adjacent industries (e.g., new car sales, energy, finance, and real estate)

SOURCE: McKinsey Global Institute analysis

Disintermediation enables OEMs and component and technology suppliers to establish direct relationships with consumers, influencing their decisions

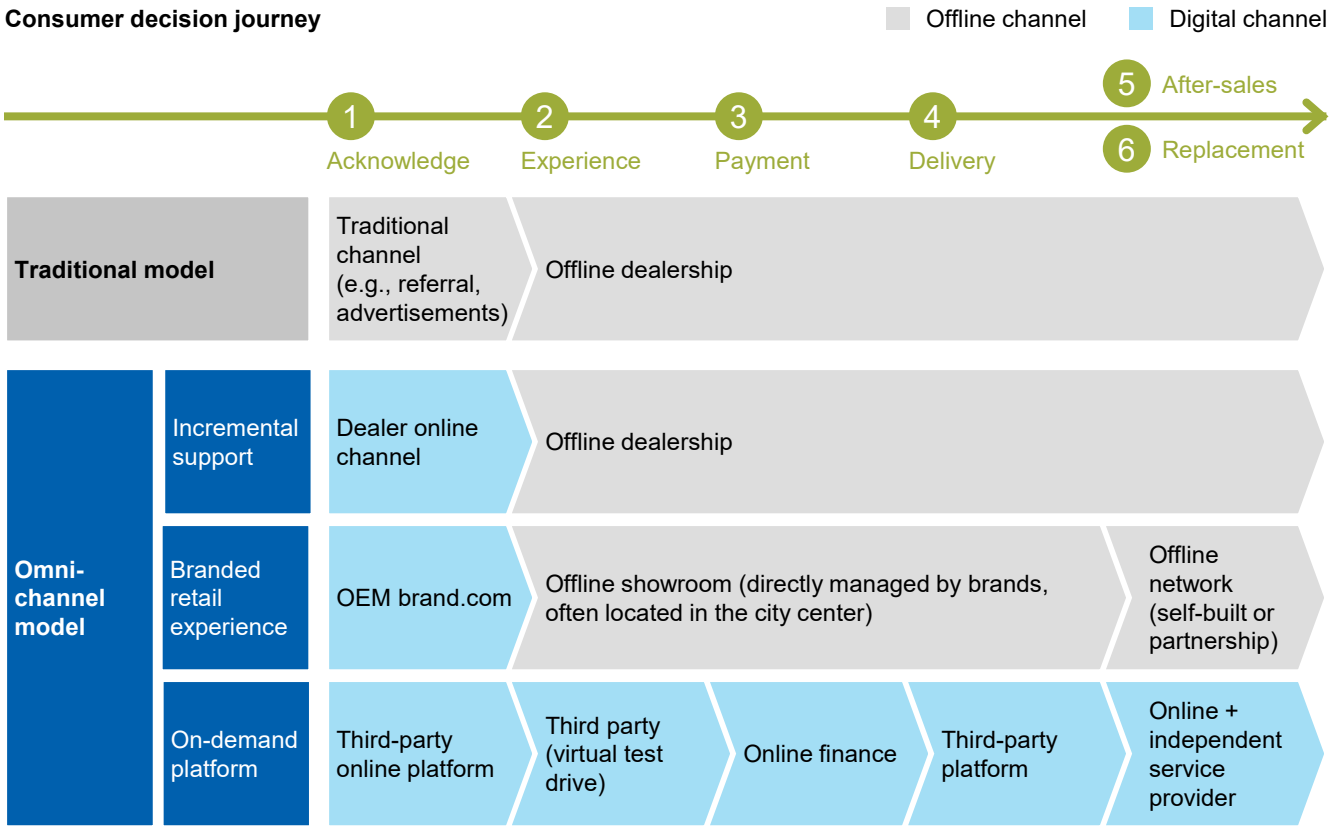
Broadly, disintermediation in the automotive and mobility industry can happen in two ways. First is the deployment of omnichannel approaches, in which OEMs serve customers directly and in the process obtain valuable firsthand insights into their purchasing preferences. In an extreme case, the entire consumer decision journey—searching for a vehicle, test-driving it, paying for it, and obtaining after-sales service—could be digitized. Dealers may play only a marginal role, or none at all. Second is car connectivity, which can enable component suppliers or providers of technology solutions to bypass OEMs and establish direct relationships with consumers through offerings such as in-car entertainment, operating systems, and other value-added services; again, having a direct line to consumers means that these companies can influence their decisions.

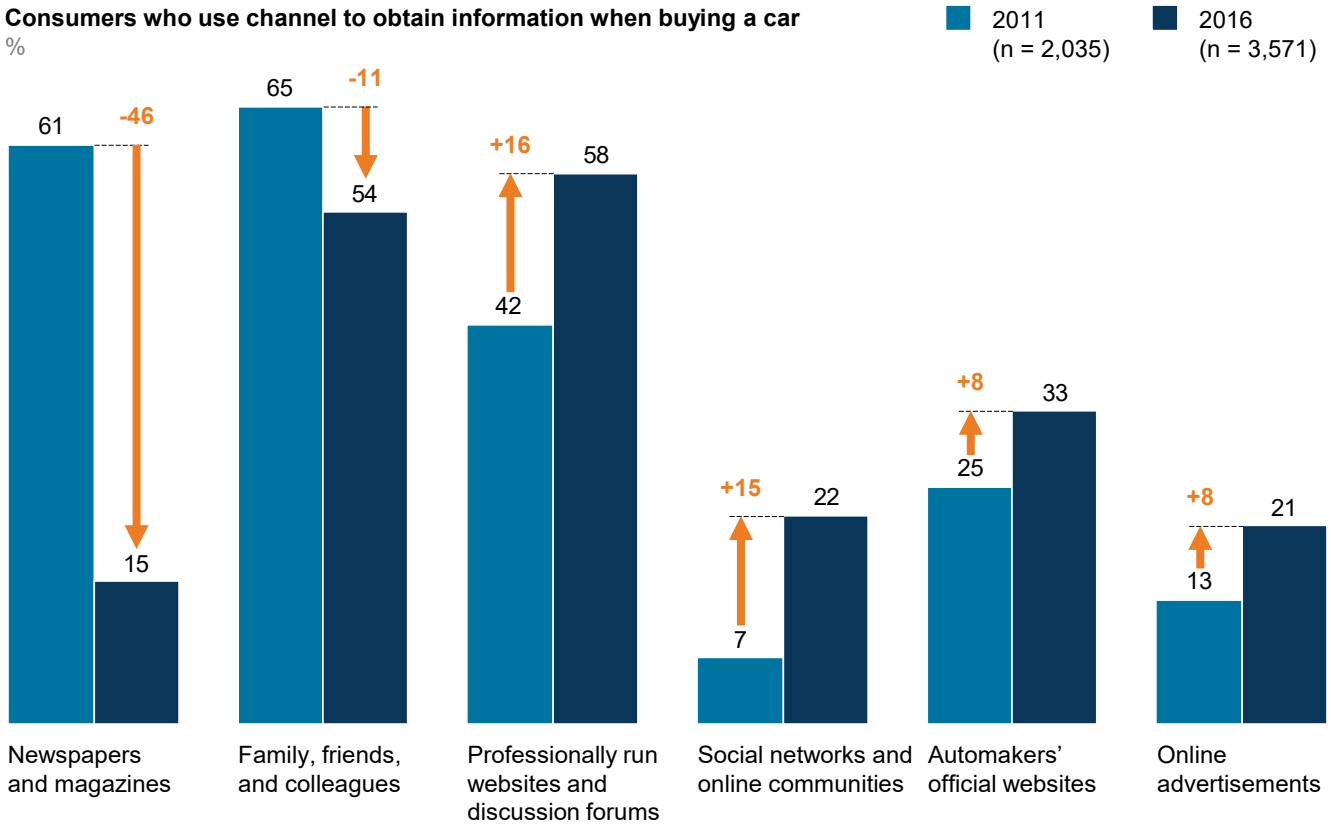
Area 1. Omnichannel

The digitization of consumer decisions in the automotive industry is not as advanced as it is in retail in China, reflecting the fact that vehicles are big-ticket items whose purchase has always entailed extensive interaction between customers and offline dealers who have long exerted significant influence over car purchases. However, direct digital channels and hyperscale platforms are now emerging in this sector, and omnichannel approaches are evolving (Exhibit 21). Three main areas are worth highlighting.

Exhibit 21

Omnichannel gives automakers and online players direct access to end customers, potentially disintermediating car dealers





SOURCE: McKinsey China Auto Consumer Survey 2016; McKinsey Global Institute analysis

- **Incremental sales support.** E-commerce solutions are not as obvious a choice in the case of expensive items such as cars as they are for less costly consumer products. Nevertheless, online car sales are happening in China on a small scale and may become more common.[158] In recent years, China's OEMs have begun experimenting with direct channels and third-party online platforms to generate online sales leads that are fulfilled offline. Geely launched the first online flagship store on Taobao in 2010, offering exclusive car models at a 20 percent discount. In 2014, the large automotive dealer Pang Da set up a joint venture with two websites, Bitauto and used-car marketplace Youxinpai, to certify used cars and sell them online. Baoxin Auto, another major dealership, launched Autostreets.com, an O2O sales platform that also offers financing, insurance, and maintenance and repair appointments.[159] By August 2015, nearly 40 dealer groups had joined Autostreets.

  Chinese consumers' appetite for buying cars online seems to be increasing. On China Singles Day in 2014, they purchased and reserved some 150,000 cars worth $5 billion; on the same key shopping day in 2015, they ordered 230,000 cars (although a significant number of these transactions did not, in the end, result in sales).[160] In 2016, Mercedes-Benz received orders for 1,256 vehicles of a single new model in 48 hours as a result of its Singles Day promotion on Tmall.[161] Selling luxury cars via e-commerce platforms is starting to take off. In 2016, Italian brand Maserati teamed up with Tmall to sell its first sports utility vehicle, the Levante, online. Fifty of the 100 cars were sold in cities where the company had no dealers, and 30 percent of the cars were sold through mobile phones.[162] According to Alibaba, Alfa Romeo sold all 350 Giulia Milano cars through Tmall within 33 seconds in March 2017.[163] In 2017, Tmall planned to launch a "mega vending machine" containing luxury cars that prospective buyers browse using their smartphones.[164]

- **Branded retail experience.** Some innovative OEMs are at least partly bypassing traditional dealership networks, with their huge suburban showrooms, and setting up branded compact showrooms in high-traffic locations in city centers. Tesla, which has been campaigning in the United States for an end to legislation prohibiting direct sales of cars, has a small showroom in Beijing that attracts more than 10,000 people a day.[165]

- **Integrated digital journey.** Car buying exhibits the potential for a revolution similar to the one retail experienced through integrated platforms such as Alibaba and Amazon. The entire process of buying a car in China is increasingly digital. Chinese consumers use offline channels less than in the past, a McKinsey China Auto Consumer Survey 2016 of more than 3,500 individuals revealed. The share of respondents saying that they use newspapers and magazines to scope potential car purchases fell by 46 percentage points to only 15 percent between 2011 and 2016. Recommendations from friends, family, and colleagues are still a significant source of information, but even they declined from 65 to 54 percent over the same period. In contrast, use of digital channels, and in particular professionally run websites, forums, and social networks and related

Use of friend and family recommendations on which car to buy dropped from **65%** to **54%** in 2011–16

[158] Alan Lau, "Online car sales in China may be closer than they appear," *McKinsey Quarterly*, October 2015.

[159] Paul Gao, Sha Sha, Daniel Zipser, and Wouter Baan, "Finding the fast lane: Emerging trends in China's auto market," *McKinsey Quarterly*, April 2016.

[160] Ibid.

[161] Li Fusheng, "Mercedes-Benz year of innovation setting the pace for future growth," *China Daily*, November 21, 2016.

[162] Du Xiaoying, "Maserati vrooms into e-tailing sector," *China Daily*, May 6, 2016.

[163] Susan Wang, *Alfa Romeo hits the gas on Tmall, sells 350 cars in 33 seconds*, Alizila, March 21, 2017.

[164] Louise Lucas, "Coming soon to China: Luxury cars sold by vending machine," *Financial Times*, August 3, 2017.

[165] *Consumer's mindset behind Tesla's popularity among people*, Diandong, May 16, 2016 (http://www.diandong.com/news/2016051611335.shtml).

communities, increased by as much as 15 percentage points. Use of OEM websites and online advertising increased by 8 percent.

The entire process of buying a car could soon be digital. The automotive company identifies the individual looking to buy a car through an online marketplace and issues an invitation to a test drive through an e-hailing platform. The customer then takes out a loan though a digital finance company and pays with a mobile phone. Even after-sales services like buying a replacement part can be done online. Autohome is now one of the most popular sources of information for prospective car buyers. Yiche, an OEM-owned website, offers a one-stop service for car buyers, including price quotations, financing, and insurance. Tuhu, an O2O aftermarket player, offers tires, maintenance, and car-decoration services online. Didi Chuxing offers test-driving services to several OEMs.[166]

Area 2. Car connectivity

60%
of Chinese survey respondents said they would switch car manufacturers to get connectivity features, vs.
20%
of German respondents

The digitization of cars is gathering pace as vehicles become the world's largest mobile devices—computers on wheels. Increasingly, cars offer the same breadth and quality of entertainment that people enjoy at home, with full connection to the cloud and analytics offering a range of applications.[167] Increased connectivity and automation offer a range of opportunities that could transform the sector.[168] McKinsey has estimated that the automotive revenue pool could expand to $1.5 trillion in 2030, with more than $100 billion of recurrent revenue coming from data connectivity services including apps, navigation, entertainment, remote services, and software updates.[169]

Consumer preferences have shifted toward connected cars quickly and are likely to continue to do so. This trend is already advanced in China. Survey evidence suggests that Chinese consumers are not only eager to adopt all that connected cars have to offer but are also willing to pay for the features. In the 2015 McKinsey Connectivity and Autonomous Driving Consumer Survey of more than 3,000 respondents in China, Germany, and the United States, 64 percent of Chinese respondents said that they would be willing to pay for subscriptions to connected-car services, compared with only 26 percent in the United States and 8 percent in Germany (Exhibit 22).[170]

Sixty percent of Chinese respondents said that they would switch manufacturers to obtain connectivity features, compared with only 20 percent of consumers in Germany. Interestingly, more Chinese respondents said that they would be willing to share data with the manufacturers of smartphone software than with OEMs, but the opposite was true among German respondents.[171] These findings indicate that there is higher potential in China than in Germany or the United States for digital software players to shift market value from incumbents in the area of connected cars.

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[166] See *Test drive of Didi Chuxing*, Autohome, February 23, 2017 (http://chejiahao.autohome.com.cn/info/1565121), and *Didi Chuxing collaborates with Changan Ford*, Tencent, April 8, 2016 (http://auto.qq.com/a/20160408/049546.htm).

[167] *How the convergence of automotive and tech will create a new ecosystem*, McKinsey & Company, November 2016.

[168] "Connected car" describes a car equipped with communication technology that allows for the direct flow of data to and from the car, without the need for a mobile device. Besides the known communication and information services from the mobile world, a connected car can communicate directly with the cloud to offer services such as connected navigation, including dynamic routing based on traffic, weather, or road conditions, or an automatic parking spot finder that offers directions to available parking spots. A connected car will be able to exchange information in real time with its immediate surroundings, including other vehicles (vehicle-to-vehicle; V2V) and/or infrastructural elements (vehicle-to-infrastructure; V2I). This is also an enabler for data-enhanced driving functionalities such as automatic vehicle speed adjustment in accordance with traffic flow and speed limits, and collision avoidance.

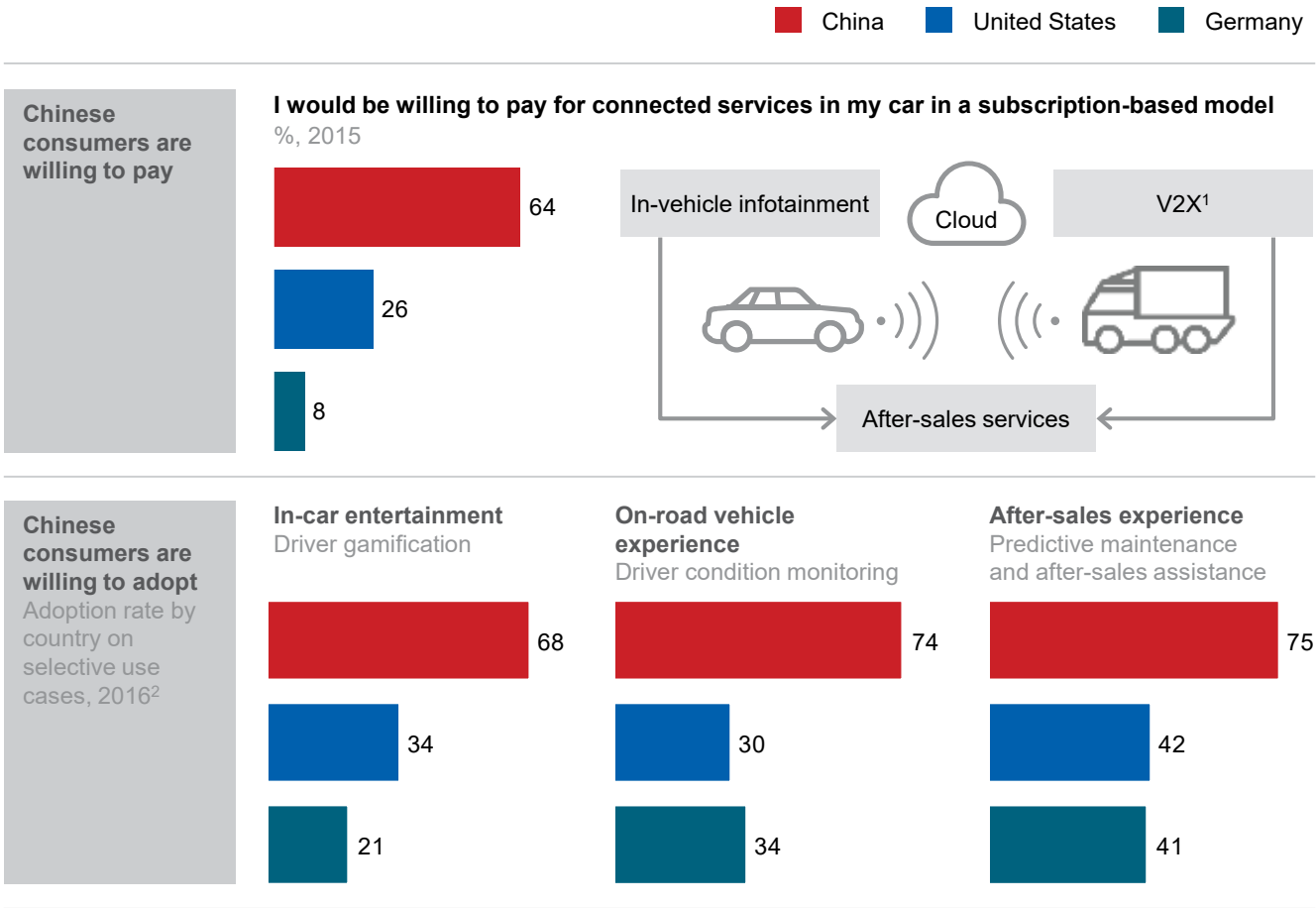
[169] *Automotive revolution—Perspective towards 2030: How the convergence of disruptive technology-driven trends could transform the auto industry*, McKinsey & Company Advanced Industries, January 2016.

[170] *Competing for the connected customer—perspectives on the opportunities created by car connectivity and automation*, McKinsey & Company Advanced Industries, September 2015.

[171] Ibid.

Exhibit 22

Chinese consumers are willing to embrace connectivity solutions in vehicles



1 V2X: Vehicle to things including vehicles, infrastructure, and network.
2 Initial adoption rate defined as percentage of respondents replying "probably" or "definitely" to these questions: (a) Relevance question: Does this solve a problem or fulfill a need for you? (b) Usefulness question: Would you be willing to use this app/system?

SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015; McKinsey Car Data Monetization Survey 2016; McKinsey Global Institute analysis

Broadly, three major types of opportunity related to connected cars emerge from our use cases in China (and around the world). The first is in-car entertainment, which gives connected devices access to e-commerce and music, for instance. In the 2016 McKinsey Car Data Monetization Survey, 68 percent of Chinese respondents said that connected entertainment features were relevant and that they were willing to try them, compared with 34 percent in the United States and 21 percent in Germany. [172]

The second type of opportunity in connected cars is the on-the-road experience, which includes the use of digital to monitor the physical condition of drivers, to report live on the condition of roads, and to offer proactive navigation services. The same McKinsey survey found that 74 percent of Chinese respondents said that such tools were useful and that they were willing to try them—more than double the share in Germany and the United States.

[172] The McKinsey Car Data Monetization Consumer Survey interviewed more than 3,000 representative recent car buyers and shared mobility users in China, Germany, and the United States (with about 1,000 respondents in each) in 2016. The objective of this survey was to understand the car-data-enabled service preferences of recent car purchasers and users of shared-mobility services. The survey had more than 70 questions covering 14 use cases (such as driving gamification, predictive maintenance and after-sales assistance, driver condition monitoring, and so on). Attributes tested included expected adoption, willingness to share data, willingness to pay for services, and views on data sharing. See *Monetizing car data: New service business opportunities to create new customer benefits*, McKinsey & Company Advanced Industries, September 2016.

Third is after-sales services. Digital solutions include sensors that monitor a vehicle's performance, track malfunctions, and enable remote, predictive maintenance—and disintermediate after-sales providers. Through such means, OEMs can observe how their products stand up to use and establish why breakdowns occur. OEMs and suppliers are still pondering what type of data they should gather, and how frequently. Again, Chinese consumers are more enthusiastic than their counterparts in Germany and the United States, with 75 percent willing to try predictive maintenance and after-sales assistance, compared with 42 and 41 percent, respectively.

Connected cars offer opportunities for large technology players and telecommunications companies to use the data flowing in and out of them to generate insights into customers' behavior and preferences, and to develop new products and services accordingly. In 2016, Alibaba and the Shanghai Automotive Industry Corporation (SAIC) launched the RX5, described as the first internet car in China. The car uses the YunOS operating system developed by Alibaba.[173] McKinsey estimates that monetizing car data could produce between $450 billion and $750 billion of revenue by 2030 globally. The size of the opportunity for automotive players depends on their ability to build and test data-driven products and services that appeal to consumers, and to develop new business models anchored on technological innovation, advanced capabilities, and partnerships.[174]

Disaggregation is transforming mobility and creating ripple effects in adjacent industries

>30%
of miles driven in new cars sold could be in the form of shared mobility by 2040

Disaggregation is a major force in the global automotive market. McKinsey finds that up to one in ten new cars sold worldwide in 2040 may be a shared vehicle used in ride hailing, car sharing or rental, and bike sharing, and that more than 30 percent of miles driven in new cars sold could be from shared mobility, revolutionizing transportation. If this trajectory were to continue, one in three new cars sold could potentially be shared in 2050.[175]

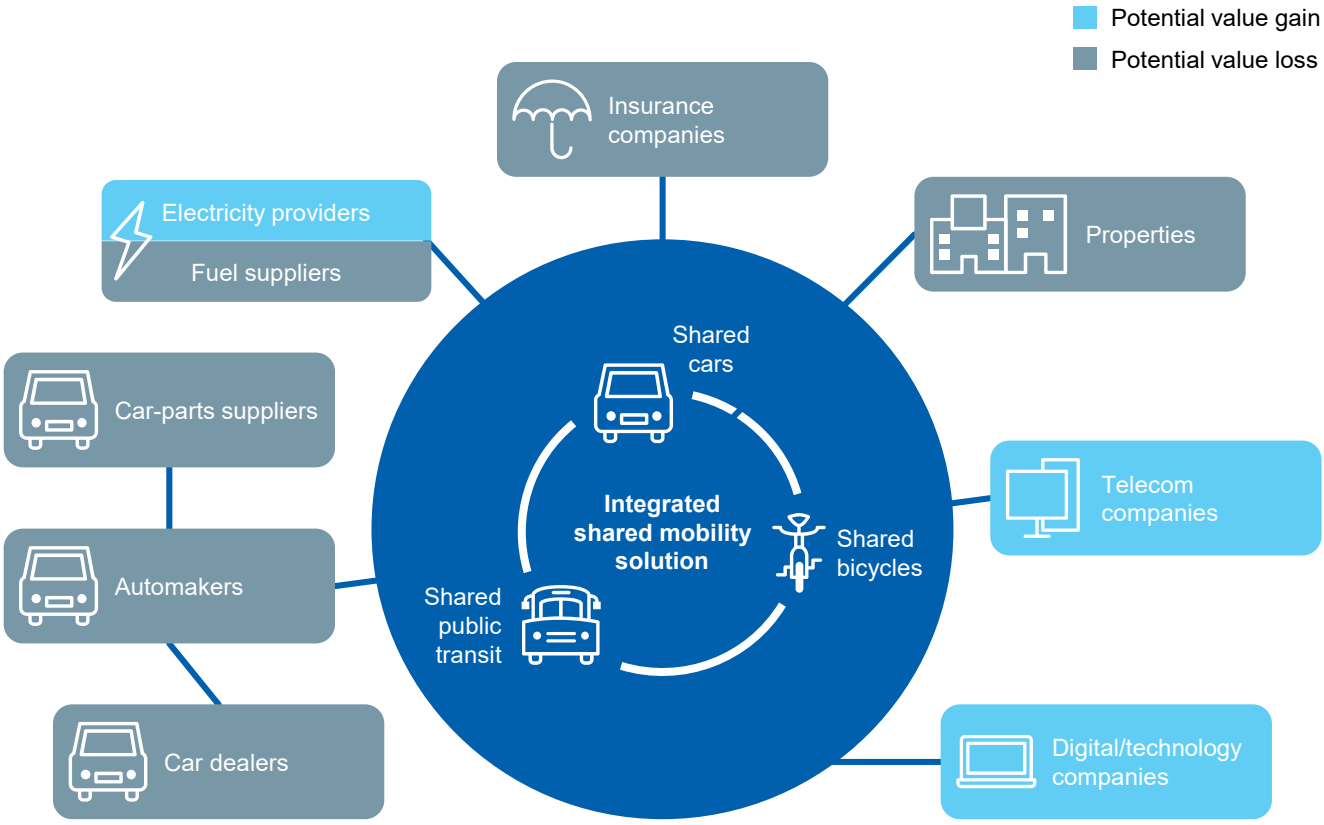
The dominant shared-mobility model today is ride sharing, but there is a move toward integrated solutions linking passenger cars, public transit, and last-mile solutions such as bicycles that will transform the way people commute, influencing the value of automotive players from OEMs to dealers, suppliers, and providers of digital mobility solutions, as well as governments, insurance companies, energy providers, and suppliers of technology (Exhibit 23).

Adoption of shared mobility also has the potential to accelerate the commercialization of autonomous and electric vehicles. Because autonomous driving, by definition, eliminates the driver—who accounts for around 45 percent of the cost of operating an e-hailing vehicle—this technology offers significant competitive advantage.[176] The business case for electric vehicles strengthens as their use increases. McKinsey has estimated that the cumulative number of electric vehicles sold could increase by up to 5 percent for every 10 percent increase in shared mobility in total journeys.[177]

[173] Tom Brennan, *Alibaba, SAIC launch YunOS-powered internet car*, Alizila, July 6, 2016.
[174] *Monetizing car data: New service business opportunities to create new customer benefits*, McKinsey & Company Advanced Industries, September 2016.
[175] *Automotive revolution—perspective towards 2030: How the convergence of disruptive technology-driven trends could transform the auto industry*, McKinsey & Company Advanced Industries, January 2016.
[176] *How shared mobility will change the automotive industry*, McKinsey & Company, April 2017.
[177] *An integrated perspective on the future of mobility*, McKinsey & Company and Bloomberg New Energy Finance, October 2016.

Exhibit 23

Integrated mobility solutions can fundamentally change how people move and create ripple effects in adjacent industries



Consumer attitudes toward car ownership are changing

60% In contrast to before, owning a car is no longer a status symbol

40% I can live without a car and I can rent when I need a car

Shared mobility solutions are penetrating rapidly

30% E-hailing or car-sharing penetration

67% 17-minute decrease in commuting time

SOURCE: McKinsey China Auto Consumer Survey 2016; China Shared Economy Survey 2017; McKinsey Global Institute analysis

Shared mobility is gaining popularity in China. According to McKinsey's 2016 China Shared Economy Survey of 2,900 urban consumers, the adoption rate of e-hailing and car sharing is already 30 percent, with tangible benefits for customers.[178] The survey found that 67 percent of respondents said that ride hailing can reduce the time it takes to commute by 17 minutes on average. One study finds that China has the greatest growth potential in car sharing because of strong demand for new cars at a time when congestion and rising air pollution are prompting tight restrictions on traffic. Eight Chinese cities have imposed restrictions on registrations of new cars.[179]

[178] The 2016 China Shared Economy Survey interviewed nearly 2,900 Chinese consumers in 40 cities to assess the impact of shared mobility, shared space, and shared skills.

[179] *The impact of new mobility services on the automotive industry*, Center for Automotive Research, August 2016.

Investment in ride hailing in China totaled $21 billion in mid-2016. Ride-hailing company Didi Chuxing has more than 50 million active users and provides more than 100 million rides a week following its acquisition of Uber China.[180] In 2016, Didi Chuxing become the second-highest-valued e-hailing unicorn in the world at $50 billion (Uber was first at $68 billion). Multinational OEMs are expanding car sharing business models in China. Daimler launched its car2go service in 2015 and now deploys more than 1,000 vehicles and has 250,000 registered users. Users can choose the rental period through WeChat and pay 6 yuan (87 cents) for 30 minutes.[181]

Last-mile solutions are emerging, too. OFO and Mobike have grown quickly to become the world's top two bike-sharing startups, with up to ten million weekly active users only three years after they were established.[182] Some companies are also experimenting with shared models in public transportation. In Beijing and Shenzhen, Didi Chuxing has conducted trials of shared bus services, serving more than 500,000 customers.[183]

Different types of mobility solutions are likely to become integrated. We are beginning to see early versions of this model emerging in some European cities. In Copenhagen, 8 percent of all journeys are integrated, allowing commuters to use an electric bicycle, a bus, or a rented electric car, or simply take a bicycle on a train. This approach helped to increase the utilization of public transport in the city by 3.4 percent in 2016.[184] In large Chinese cities such as Beijing and Shanghai, a fully integrated IoT–enabled smart-mobility model may well emerge on the back of strong government support for investment in rail and metro systems that can generate significant economic and social benefits.[185]

26%
of Chinese survey respondents said they would consider car sharing

These trends are likely to accelerate in China given consumers' changing attitudes toward car ownership. In the 2016 China Auto Consumer Survey, 60 percent of respondents said that owning a car was no longer a status symbol, and 42 percent said that owning a car was less appealing today because of high maintenance costs and worsening traffic congestion.[186] In addition, 37 percent said there were more alternative transportation options available that could substitute for car ownership. Among the alternatives, up to 40 percent of respondents said that they would consider renting a car, and around 26 percent said that they would consider car sharing.

These trends and attitudes point to a significant challenge to sales of new and used cars that will affect OEMs, dealers, and suppliers of car parts. Shared mobility clearly has the potential to pose formidable competition for traditional players such as taxi firms, but also to affect adjacent industries.

Take insurance as an example. Today, car insurance accounts for around 80 percent of non-life insurance in China. If the number of private vehicles sold declines because of a move toward shared mobility, fewer car-insurance policies will be written. Moreover, some "drivers" of autonomous vehicles may take the view that they are so safe that they don't need insurance. On the other hand, IoT and connected cars can help to reduce overclaiming—

[180] *Car sharing in Europe: Automakers take the spotlight*, Bloomberg New Energy Finance, September 2016.
[181] Wang Ying, "Car2go expects big growth in vehicle-sharing market," *China Daily*, April 22, 2017.
[182] *2017 China's sharing bicycle industry report*, iResearch, March 22, 2017 (http://report.iresearch.cn/report/201703/2961.shtml).
[183] Erik Crouch, *Didi Kuaidi wants to make 'tech buses' a common commuter option in China*, Tech in Asia, October 19, 2015.
[184] See *Sustainable urban transportation: Creating green liveable cities*, Think Denmark white paper, June 2016; and *Copenhagen wins smart city award*, Ministry of Foreign Affairs of Denmark, November 11, 2014.
[185] Jonathan Woetzel and Ting Wu, "China shared economy," McKinsey China press release, August 2017; *An integrated perspective on the future of mobility*, McKinsey & Company and Bloomberg New Energy Finance, October 2016.
[186] The China Auto Consumer Survey interviewed more than 3,500 consumers in order to measure changing consumer behavior and attitudes toward cars. See McKinsey & Company, *Finding the fast lane: Emerging trends in China's auto market*, April 2016.

the claims ratio stands at a very high 58 percent in China—and fraudulent claims.[187] These unwelcome costs could be minimized if shared mobility players were to use their market clout to move toward usage-based insurance. One study suggests that usage-based insurance penetration could reach 10 to 15 percent in China even in a conservative scenario by 2020.[188] In light of this competitive challenge, car insurers should consider changing their business models. Traditionally, car insurers have provided consumer coverage in the event of accidents caused by human error. However, if driverless vehicles become more prevalent, auto insurers might begin to shift toward largely insuring car manufacturers from liabilities related to technical failures by autonomous vehicles. The insurance industry could move from having millions of private customers to having just a few OEMs and infrastructure operators, similar to insurance for cruise lines and shipping companies.[189]

If and when growth in car sales slows down because of higher penetration of shared mobility, and as use of electric vehicles becomes more prevalent, oil and gas producers are likely to face downward pressure on sales. In the case of electric vehicles, penetration is likely to increase partly because of a regulatory push by governments concerned about air pollution. Shanghai, for instance, charges for registration plates on cars powered by internal combustion engines but allows free plates for electric vehicles. In the city, more than one-fifth of cars used for shared mobility are electric. By 2030, battery electric vehicles could command 24 percent of the light-duty vehicle market, according to Bloomberg New Energy Finance.[190] In essence, a portion of demand for oil and gas will be replaced by demand for electricity. McKinsey finds that the combined effect of ride sharing and electric vehicles could cut downstream demand for fuel by 60 to 75 percent from 2015 to 2030, depending on the type of city. In cities that transition rapidly toward seamless mobility or clean and shared systems, local demand for light-vehicle fuels could fall by as much as three-quarters over this period.

Another sector that may lose value is real estate. An increase in shared and autonomous vehicles could mean that there is less demand for parking facilities, and these could be turned into urban green spaces or other public spaces.[191] An app called ReStreet, developed at the University of San Francisco and California Polytechnic State University, is intended to give urban citizens a say in how their city could be redesigned in an era of autonomous vehicles.[192]

Disintermediation and disaggregation can shift significant value across the automotive and mobility value chain

Disintermediation and disaggregation can shift a great deal of value across the value chain. Our simulation indicates that traditional automakers and components suppliers might lose value equivalent to 2 to 10 percent to new digital attackers such as digital software and hardware players and providers of mobility solutions.[193] In addition, providers of new digital solutions can capture new market opportunities representing 10 to 28 percent of industry revenue through monetizing direct relationships with consumers (Exhibit 24).

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[187] See *2016 Insurance statistics report*, China Insurance Regulatory Commission, February 22, 2017 (http://www.circ.gov.cn/web/site0/tab5257/info4060001.htm), and *Car insurance loses up to 6.3 billion in 2016*, iRead, October 8, 2017 (https://www.iread.one/23035.html).

[188] *UBI auto insurance outlook in 2020*, Sinoins, June 22, 2016 (http://chx.sinoins.com/2016-06/22/content_199059.htm).

[189] McKinsey & Company, *Ten ways autonomous driving could redefine the automotive world*, June 2015.

[190] *Electric vehicle outlook 2017*, Bloomberg New Energy Finance, July 2017.

[191] *An integrated perspective on the future of mobility*, McKinsey & Company and Bloomberg New Energy Finance, October 2016.

[192] Laura Bliss, *An app for democratizing street design*, CityLab, September 25, 2017.

[193] This does not mean that the revenue of traditional players will decline. They can still continue to grow by capturing opportunities from natural market growth. They can also capture upside in new digital businesses by sometimes disrupting their own business models themselves.

Exhibit 24

Disintermediation and disaggregation can shift value from traditional automotive players to providers of digital solutions

SIMULATION

Case Low High

	Disintermediation		Disaggregation		Value shift by sector stakeholders, 2030 % of industry revenue pool
Traditional automakers	↑	Opportunities to serve consumers directly (e.g., online sales, after sales)	↓	New car demand and average sales price decline due to emergence of shared mobility solutions	-10 to -2
	↓	Digital suppliers might bypass automakers (e.g., connectivity solution)			
Components suppliers	↑	Opportunities in connectivity components	↓	Chain reaction from declining new car sales	
	↓	Threats to companies focusing on traditional components			
Dealers and distributors	↓	Potential threat due to declining role of intermediaries in omnichannel	↓	Chain reaction from declining new car sales	-5 to -2
Digital solutions provider	↑	New opportunities to monetize digital consumer decision journeys and offer connectivity solutions (both hardware and software)	↑	New opportunities to offer mobility solutions and monetize customer relationships	10 to 28

SOURCE: McKinsey Global Institute analysis

Traditional OEMs and car component suppliers are likely to be vulnerable to value loss

Disintermediation could provide opportunities but also pose threats to OEMs. This digital force offers increased scope for OEMs to sell directly to consumers and influence their purchasing decisions through omnichannel strategies. OEMs may also be able to increase their share of the after-sales services market by providing direct services through independent services providers. Some are already seizing this opportunity. For example, SAIC launched Chexiang, a platform that services non-SAIC customers. Data from connected vehicles can help OEMs understand, and therefore target, their customers more effectively, and build stronger brand loyalty. However, digital platforms also enable providers of digital solutions to bypass OEMs and build their own direct relationships with customers. If customers value digital features such as operating systems and in-car entertainment rather than specific OEM brands, even more value could shift to digital attackers. Traditional OEMs and components suppliers also stand to lose from lower sales of new cars as shared mobility penetrates. If shared-mobility players were to commercialize autonomous driving technology and make it more affordable for consumers, the shift in value away from OEMs and parts suppliers could be even more significant. In our simulation, we estimated that the combined impact of disintermediation and disaggregation could shift between 2 and 10 percent of value from traditional OEMs and suppliers to providers of digital solutions such as connected-car software and shared mobility.

Car dealers and distributors are vulnerable to disintermediation as well as a chain reaction from shared mobility

Even as online car sales start to become more popular in China, OEMs still use dealers for fulfilment of online orders and the delivery of cars to customers. However, as omnichannel evolves and OEMs find alternative partners to perform tasks digitally, traditional dealers could find themselves increasingly out of the loop. If disaggregation reduces demand for new cars, and autonomous vehicles that reduce the number of accidents due to human driving error become more prevalent, the after-sales market will shrink for dealers who today account for 60 percent of the market. In our simulation, car dealers and distributors may lose value equivalent to 2 to 5 percent of the industry revenue pool as omnichannel shifts business toward OEMs and shared mobility moves business toward providers of digital solutions.

Providers of digital solutions can capture upside from new business opportunities

Rising interest in connected cars opens up the market to new players from other sectors, including high tech and media, and offers more opportunity to suppliers of hardware and software. Connected cars need chips, sensors, and cloud platforms to be able to detect other vehicles and infrastructure, and to connect to the network. Software companies can play the role of integrator by developing technology platforms that increase connectivity between vehicles, infrastructure, and people, including operating systems and high-precision maps. Third-party online players can provide niche value-added services such as test-driving cars (as Didi Chuxing does), car delivery (eDaijia), online auto loans and insurance (Chedai), business-to-customer and B2B after-sales services (Xiaokakejie), and online sales of auto parts (TQmall).

Providers of mobility solutions can use their large user bases to expand from mobility into financing, test driving, and even matchmaking among people who book rides based on their shared interests, for example.[194] Large-scale mobility companies can move upstream by developing purpose-built vehicles equipped with only necessary functions that can cost 25 percent less than vehicles with full functionality.[195] Providers can also adopt autonomous driving technologies that could cut labor costs and further promote shared mobility.

In our simulation, providers of digital solutions could capture opportunities equivalent to 10 to 28 percent of the industry's revenue pool by offering new hardware, software, and services that are more cost-effective and offer improved convenience.

Dematerialization—namely 3-D printing in car production—has a smaller potential impact than the other two digital forces

Dematerialization has some potential to disrupt value chains in the automotive and mobility sector—moving value from suppliers to OEMs—but the impact is likely to be smaller than that of the other two digital forces that we have discussed. In automotive, 3-D printing is largely relevant to the manufacture of cars for premium customers who want customized features. However, some car manufacturers have attempted to use this technology in assembly lines to print seats, water pumps, and interiors. For instance, Toyota Central R&D Labs uses 3-D printing to produce car seats that can improve the function of heating and reduce the absorption of heat from the sun. BMW has developed a 3-D–printed, light-metal water pump wheel; one of these pumps was used in a car racing in the German Touring Car Masters.[196] Some companies are even more ambitious. US company Local Motors aims to

[194] "The ambitions of Didi Kuaidi, Uber's Chinese rival, go far beyond taxi-hailing," *The Economist*, January 30, 2016.

[195] McKinsey & Company, *How shared mobility will change the automotive industry*, April 2017.

[196] See Jason Brick, *Print your next car seat for improved fuel efficiency*, PSFK, October 2015, and *Racing technology right from the 3D printer: BMW makes water pump wheel for DTM racecars using additive production method*, BMW press release, April 29, 2015.

produce about three-quarters of its LM3D model with 3-D printing; its long-term goal is to produce 90 percent of this car using the technology.[197] Another automaker, Divergent 3D, showed its 3-D–printed Blade Supercar at the Los Angeles Auto Show in 2016.[198]

A NUMBER OF FACTORS WILL DETERMINE WHETHER, AND WHEN, DISRUPTION WILL OCCUR

China aims for **10%** of cars to be fully self-driving by 2030

These three types of digital forces are at different stages, so anticipating when they are likely to have a marked impact on China's automotive and mobility sector is not easy. Nevertheless, some factors may influence their penetration and impact.

- **Will industry standards and technology develop quickly enough to support adoption of digital solutions in the automotive and mobility sector?** Establishing industry standards is a vital prerequisite for the development and adoption of connected cars and shared mobility. MGI research on IoT suggests that interoperability is required to capture nearly 40 percent—and, in some cases, 60 percent—of the total potential of this technology.[199] The development of connected vehicles and autonomous driving is heavily dependent on how the hardware and software embedded in the mobility infrastructure operate. This, in turn, hinges on huge investment in that infrastructure as well as collaboration among players from different sectors including automotive, software (analytics), hardware (sensors), energy (charging), and telecommunications (5G).

  The technology itself also needs to advance. In autonomous driving, China has set an ambitious target. It aims for 10 to 20 percent of vehicles to be highly autonomous by 2025, and for 10 percent of cars to be fully self-driving in 2030.[200] But the industry will not meet the targets unless it overcomes certain technical barriers. McKinsey anticipates vehicles meeting the high-automation level (defined by SAE International as Level 4) emerging over the next five years.[201] While the technology is ready for testing in limited situations, it may take years to complete testing and validation because these cars will face so many uncommon situations. SAE International's Level 4 and Level 5 of automation require these vehicles to be operated in any environment, and more progress will be needed to reach that bar. The main issue is the development of the required software. Hardware can deliver the computer power required, and its price is likely to continue to fall (especially the price of sensors), but software may remain a bottleneck.

- **How quickly are consumers likely to adopt and embrace digital solutions?** One factor that may stand in the way of consumer adoption of connected cars is concern about data privacy and security; this will need to be addressed. Today's typical car already has the computing power of 20 personal computers, features about 100 million lines of programming code, and processes up to 25 gigabytes of data an hour. This means cars are exposed to hacking and that a simple system failure could be catastrophic. According to the McKinsey Connected Car Consumer Survey, 53 percent of new car buyers in China expressed concern about hackers manipulating the car—its braking system, for instance—if the car is connected to the internet.[202] In the case of shared mobility, Chinese consumers are generally more concerned about the safety and security of cars that are e-hailed than their counterparts in the United States. Interestingly, US consumers adopt ride hailing because they believe it to be safer than

[197] Sophie Curtis, "'World's first 3D-printed car' to go on sale in 2016," *The Telegraph*, November 6, 2015.
[198] Jess Vilvestre, *This is the world's first 3D-printed "supercar,"* Futurism, November 20, 2016.
[199] *The Internet of Things: Mapping the value beyond the hype*, McKinsey Global Institute, June 2015.
[200] "China sets target for self-driving cars to encourage development," Bloomberg News, October 26, 2016.
[201] The level 4 SAE International Standard is defined as the vehicle having an automated driving system that undertakes all aspects of dynamic driving even without human drivers responding to requests for intervention. See *Self-driving car technology: When will robots hit the road?* McKinsey & Company, May 2017.
[202] *Connected car, automotive value chain unbound*, McKinsey & Company Advanced Industries, September 2014.

taxis, but the opposite is true in China. Only 16 percent of Chinese respondents think ride hailing is safe, compared with 32 percent who think conventional taxis are safer.[203]

- **Will regulation support changes?** Regulation can either hold back digital disruption in the automotive and mobility sector or enable it. China made shared mobility legal in 2016, in contrast to many other countries that prohibit this model of transportation, and the decision powered the rapid growth of shared mobility. Further development of shared mobility will depend on a range of regulations, including those on the use of land in urban areas, the taxation of e-hailing and ride sharing, and labor requirements on e-hailing drivers. Policy makers want to balance the development of shared mobility against the interests of conventional taxi businesses.[204] China has new regulations stipulating that ride-hailing apps can hire only local residents in Beijing and Shanghai; these regulations may limit growth in the sector given that many drivers today are believed to come from out of town.[205] The development of omnichannel approaches will also depend on the shape of regulation. Current regulations prohibit direct sales by OEMs in areas where dealership networks are in place, and this may limit OEMs' incentives to explore more aggressive approaches.

  Similarly, the speed at which autonomous driving develops will depend on how much room for innovation and experimentation the government allows. Nearly ten ministries and departments are involved in regulating autonomous vehicles, and they need to work together in a coordinated way. One way to achieve this would be to develop a national policy framework for autonomous vehicles. In addition, the government needs to invest in highway infrastructure for autonomous vehicles, eliminate today's prohibition on road testing, and reduce restrictions on the development of road maps so that OEMs and software designers can craft the most accurate navigational guides.[206] At the city level, approaches to autonomous driving vary. Some cities are proactively pushing car connectivity and autonomous driving technology. For example, the government of Zhangzhou is an active investor in autonomous driving, with a plan to construct a 56-square-kilometer zone where autonomous cars can be tested.[207]

[203] Jonathan Woetzel and Ting Wu, "China shared economy," McKinsey China press release, August 2017.

[204] *Urban mobility at a tipping point*, McKinsey & Company, September 2015.

[205] Jon Russell, *New regulations could limit Didi's taxi on-demand service in China's top cities*, TechCrunch, December 21, 2016.

[206] Darrell M. West, *Moving forward: Self-driving vehicles in China, Europe, Japan, Korea, and the United States*, Center for Technology Innovation at Brookings, September 2016.

[207] Li Fusheng, "China to build world's largest autonomous driving testing zone," *China Daily*, January 2017.

HEALTH CARE: BUILDING A PATIENT-CENTRIC SYSTEM

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95%
of Chinese population covered by health care

China has substantially improved its health-care services, especially since its reform of the system in 2009.[208] Health-care spending has been growing five to ten percentage points faster than GDP over the past decade, and today China has near-universal health-care coverage, with 95 percent of the population covered. However, the system still faces a range of challenges, which digital technologies can help address. Of particular interest are new business models such as health-care big data, IoT–enabled treatment, and AI-empowered diagnosis that enables personalized treatment and puts patients at the center of health care.

Despite the rapid increase in health-care spending over the past decade, spending accounts for only 6 percent of GDP, compared with an average of 9 percent in OECD countries in 2014. On a purchasing power parity basis, China's per capita health-care expenditure is about 20 percent of Japan's and 30 percent of South Korea's, according to WHO. China's regions exhibit a pronounced imbalance of resources. For instance, urban residents have two to three times better access to health-care professionals than their rural counterparts.[209] Fifty-one of China's top 100 hospitals are located in only three cities—Beijing, Guangzhou, and Shanghai—according to Fudan University.[210] As China's population ages and incomes rise, citizens will demand more, and higher-quality, health-care services, and the pressure to further develop the capacity and quality of health-care infrastructure will increase. This pressure has already encouraged the government to turn to digital solutions, which can bring significant potential benefits for the key stakeholders in the system.

- **Patients.** Digital technologies can help to ensure that patients find it easier to access and afford high-quality health-care services. AI-enabled solutions can empower them by making them more informed and more directly involved in their diagnosis and treatment. Transparency about the cost of treatment and online health-care communities can enable patients to have intelligent conversations with providers of health-care services, and thereby help reduce overcharging and overtreatment by hospitals. There is significant scope for more personalized and more patient-centric clinical programs, which could be realized if more comprehensive personal medical information were made available. Utilizing digital technologies and data can enable more holistic health management, improved patient compliance, and reduced cost. Digitization of health-care data makes it possible to put those data back into the possession of patients instead of hospital "archives," helping patients to take charge of their own health.

- **Health-care providers and payors.** A more digitally driven health-care system that improves access in areas that are currently underserved, coupled with lower costs through the sharing of resources, more efficiency, and more standardized treatments enabled by big data, can benefit providers. Digital technologies can help to minimize information asymmetries and pricing variations by providing improved visibility on how much is charged for the same treatment by hospitals in different areas, and on outcomes. Outcome-based pricing creates more transparency about the cost of treatment, and should help to reduce overcharging and overtreatment by hospitals. A true industry-wide pool of big data can help payors optimize treatments and make the entire system more cost-efficient.

- **Pharmaceutical and medical-technology companies.** Pharmaceutical and medical-technology companies can substantially improve how they engage patients using digital means. Digital devices and apps can reveal a lot more information on the performance of products in real time. Data-driven insights generated from the real world can help these companies to improve the efficiency of their R&D. They can also offer personalized-care

[208] *China's health-care reforms*, McKinsey & Company, 2010.

[209] Jianlin Hou and Yang Ke, "Addressing the shortage of health professionals in rural China: Issues and progress," *International Journal of Health Policy and Management*, volume 4, issue 5, May 2015.

[210] *China best hospitals rankings*, Hospital Management Institute of Fudan University, 2015 (http://www.fudanmed.com/institute/news222.aspx).

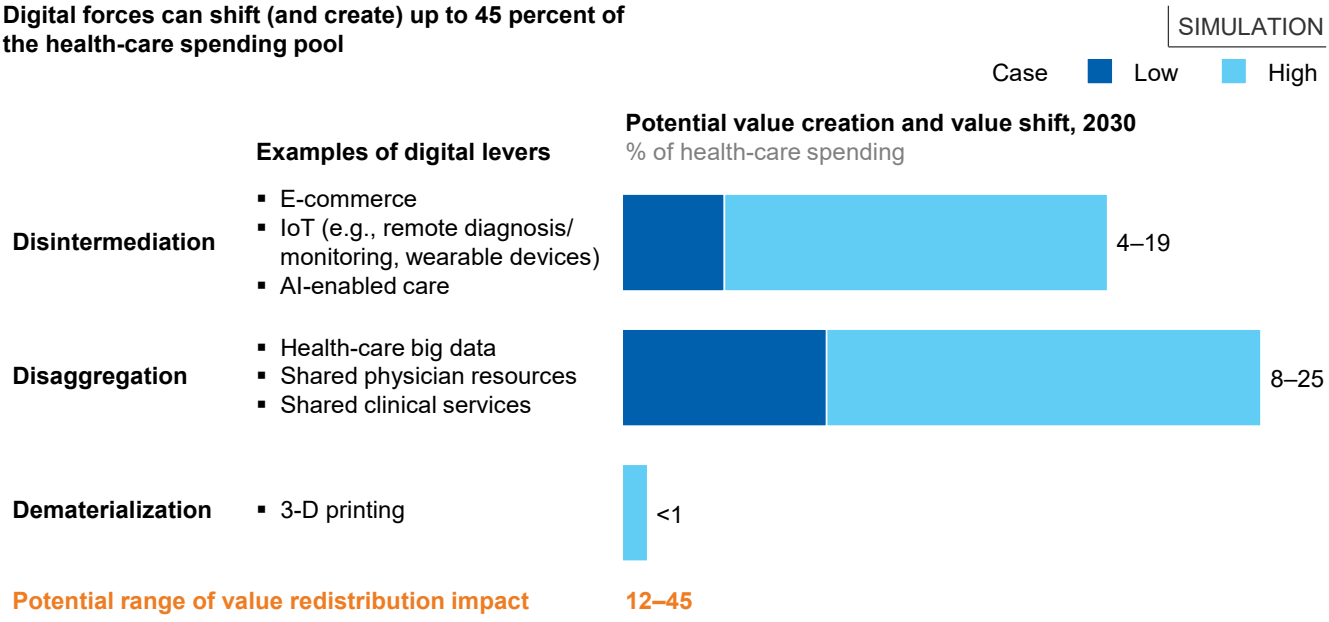
solutions that will not only help them capture revenue upside but also strengthen the loyalty of patients.

- **Health-care system.** Since 2015, the government has made smart health care a priority through its Internet Plus Health policy and its Healthy China 2030 initiative.[211] The government aims to establish interconnected health-care digital platforms to meet the needs of personalized health care and promote the application of big data, the matching of medical resources, and the sharing of those resources. Among a range of targets for 2030 set by the government for healthy living and health-care coverage is the aim of increasing the registered doctor coverage ratio from 2.2 per 1,000 population in 2015 to 3.0, reducing the premature mortality rate of major chronic disease by 30 percent from the 2015 level, and increasing the size of the health-care market by up to 1.6 trillion renminbi ($241 billion). These aims were re-emphasized in the Internet Plus Health Care plan unveiled early in 2017, which discussed optimizing traditional ways of treating patients through one-stop health-management services and allowing patients to gain access to and monitor their own medical data through mobile terminals.[212]

Our analysis finds that digitization can shift and create new value on the order of 12 to 45 percent of health-care spending (Exhibit 25). As the value chain is restructured, more efficient players can emerge and gain share from incumbent players by serving patients better. Digital solutions and healthy competition will save on health-care expenditure, which can then be reinvested to improve coverage and quality of services, eventually leading to higher productivity.

Exhibit 25

Digital forces can shift (and create) up to 45 percent of the health-care spending pool



NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

[211] *Healthy China 2030 Plan*, National Health and Family Planning Commission, August 25, 2016 (http://www.nhfpc.gov.cn/xcs/wzbd/201610/21d120c917284007ad9c7aa8e9634bb4.shtml).

[212] *General Office of the State Council's guidance about promoting digital health care*, General Office of the State Council, June 24, 2016 (http://www.gov.cn/zhengce/content/2016-06/24/content_5085091.htm).

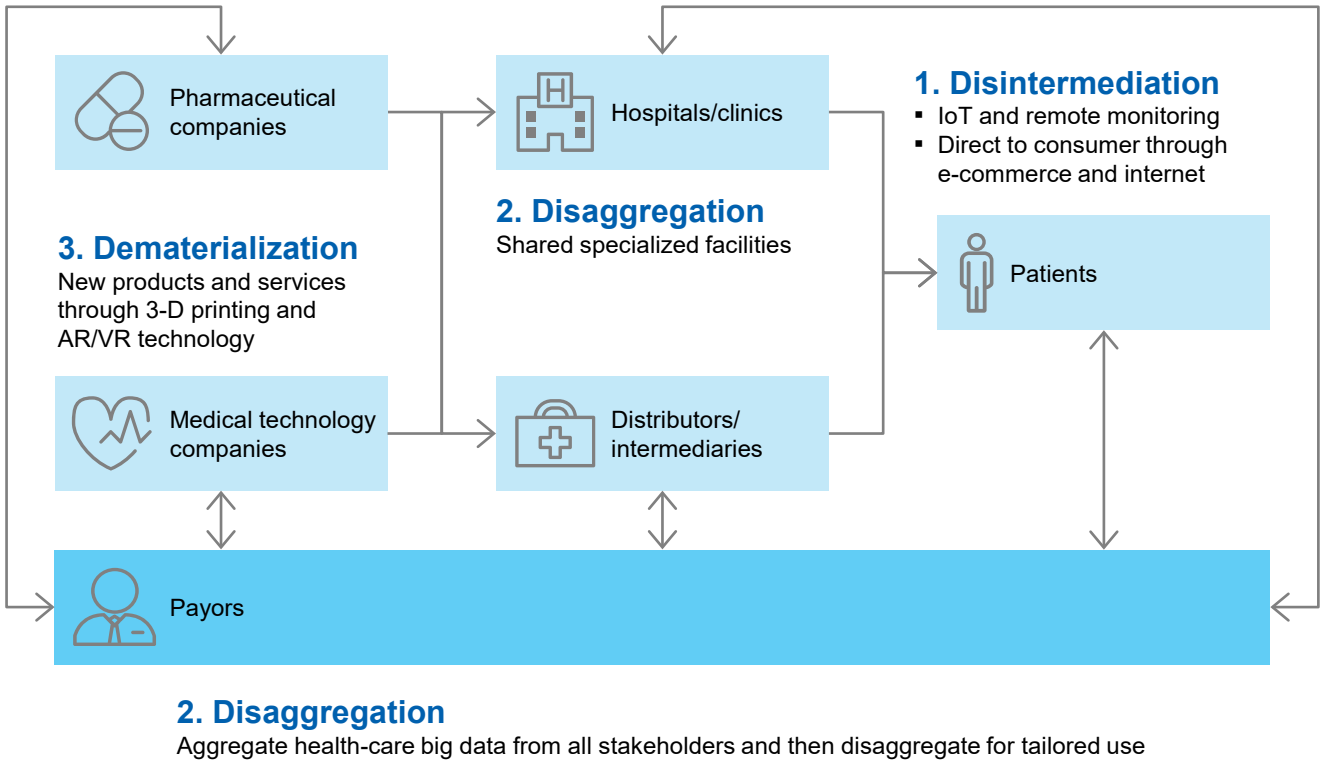
BY RESTRUCTURING VALUE CHAINS, DIGITIZATION CAN POTENTIALLY SHIFT (AND CREATE) UP TO 45 PERCENT OF HEALTH-CARE EXPENDITURE

Our simulation finds that digitization can shift, and create, value on the order of 12 to 45 percent of the industry's expenditure. The major impact of digitization in health care comes from disintermediation and disaggregation in our simulation. Using IoT, AI-enabled care, and e-commerce could potentially shift 4 to 19 percent of health-care expenditure by establishing direct connections with patients, disintermediating traditional health-care providers and channels. Disaggregation through the use of big data and shared resources such as physicians and specialized facilities could shift between 8 and 25 percent of health-care spending from inefficient players to providers of more efficient solutions. Dematerialization through the use of virtualized product design and production can create opportunities for digitally enabled new attackers to enter the sector, but our analysis suggests that the potential impact is likely to be far smaller than that of the other digital forces.

To understand how value can shift as the result of the three major types of digital disruption, we analyzed 55 use cases in health care and mapped them along the value chain (Exhibit 26). We looked in particular detail at disintermediation and disaggregation.

Exhibit 26

Three digital forces can restructure health-care value chains



SOURCE: McKinsey Global Institute analysis

Disintermediation can improve prevention, diagnosis, and treatment by offering patients timely and continuous health-care access

We look in particular at three forms of disintermediation in health care: IoT and remote monitoring, AI-enabled care, and e-commerce.

85%
of deaths in China from chronic disease vs.
65%
global average

Area 1. IoT and remote monitoring

Health-care players can use IoT technology to enable direct connections with patients and conduct digital health- and wellness-management programs remotely.[213] These digital forms of health care could significantly reduce the per-patient cost of treatment.[214] Moreover, they could change incentives and behavior, creating a new focus on prevention, disease management, and wellness.

IoT solutions can help address China's chronic and non-communicable diseases (NCDs), which are now the leading cause of disease around the world. China is home to an estimated 260 million patients with chronic disease, and the number is likely to continue to increase. The Ministry of Health estimates that chronic disease causes 85 percent of all deaths in China.[215] The global average in 2010 was 65 percent.[216] The incidence of NCDs, notably hypertension, diabetes, heart disease, and strokes as well as obesity, is rising in China (as in many other countries). This reflects a range of factors including lack of physical activity, unhealthy eating habits, altered sleep patterns, environmental pollution, and tobacco and alcohol abuse. One major challenge is the fact that patients often don't know whether they have these diseases. For instance, only 33 percent of Chinese diabetics are receiving treatment for their condition, compared with 59 percent in the United States and 50 percent in Japan. China spends $50 billion on treating diabetes and related diseases every year, or about 13 percent of national health-care spending. Of that total, 80 percent goes toward treating complications of the disease and only 20 percent toward its prevention.[217] The World Bank estimates that, taking into account the impact of NCDs on the supply of labor and capital accumulation, the five major NCDs are expected to cost $27.8 trillion in China between 2012 and 2030.[218]

IoT–enabled solutions can help address these challenges (Exhibit 27). Wearables embedded with medical big data, for instance, can alert patients to changes in the condition of their health. Chinese consumers seem to be open to these solutions. In 2015, adoption of wearable mobile health technology (or web-connected monitoring systems) was about 12 percent in the case of diabetes and 11 percent for heart disease, compared with 6 percent and 4 percent, respectively, in the United States. Lifesense, a wearable device maker, offers products including wearables, scales, and blood pressure monitors that enable customers to track their health and receive lifestyle recommendations. Tencare Doctor Tang from Tencent is a device that measures blood sugar using an IoT sensor that collects patient information digitally. The device stores results in an easily accessible

[213] MGI research has found that using IoT in health care could have an economic impact of $1.1 trillion to $2.5 trillion a year by 2025. MGI found that use of the mobile internet could cut global health-care costs by $0.9 trillion and $2.1 trillion a year in the period to 2025, including a saving of 10 percent to 20 percent on the cost of managing chronic diseases through remote health monitoring. See *Disruptive technologies: Advances that will transform life, business, and the global economy*, McKinsey Global Institute, May 2013.

[214] One example of the savings potential from remote monitoring devices is the US Veterans Health Administration, which provided such devices to more than 70,000 patients with chronic diseases, combined with access to video chats with physicians. These patients used 20 percent to 50 percent fewer resources. See Andrew Broderick and David Lindeman, "Scaling telehealth programs: Lessons from early adopters," *Case Studies in Telehealth Adoption*, The Commonwealth Fund, January 2013.

[215] See *Nutrition and chronic conditions of Chinese residents report*, National Health and Family Planning Commission, June 30, 2015; Angela Wang, "Chronic diseases cause 85 percent of deaths in China, says report," *The Epoch Times*, July 10, 2012; and *Global status report on noncommunicable diseases 2014*, World Health Organization, 2014.

[216] In 2010, 47 percent of the Chinese male population smoked; 81 percent of the population male and female had a high salt intake of more than five grams a day; 83 percent had an intake of cooking oil of more than 28 grams a day; more than half the population ate less than 400 grams a day in fruit and vegetables; 17 percent consumed 15 or more alcoholic drinks in a week in the case of men and eight or more in the case of women; and only 12 percent of the population took regular physical exercise. See Yan Min et al., "Tackling China's noncommunicable diseases: Shared origins, costly consequences and the need for action," *Chinese Medical Journal*, volume 128, number 76, March 20, 2015.

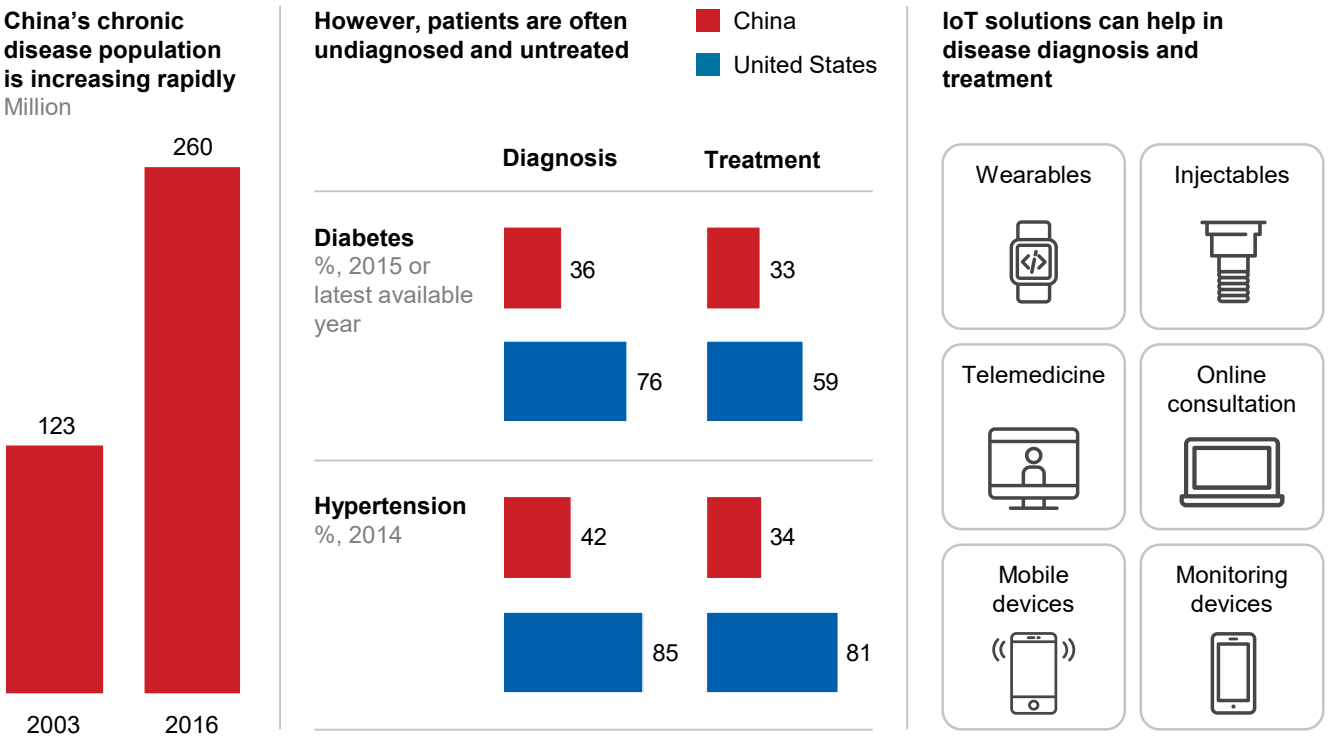
[217] *The faces of innovation: Meeting the challenge of diabetes*, R&D-Based Pharmaceutical Association Committee, 2016.

[218] *Healthy China: Deepening health reform in China: Building high-quality and value-based service delivery*, policy summary, China Joint Study Partnership, 2016.

database. The app connects registered family members and friends via WeChat, which can send an instant alert about the patient's blood-test results.[219] Online consultation apps are emerging, too. Spring Rain Doctor helps patients look up medical information on its mobile platform and connects them with doctors for remote consultations. Alihealth, an Alibaba affiliate, acquired WlyCloud, a telemedicine imaging company, to serve small hospitals in small cities and rural areas.

Exhibit 27

IoT devices in health care can help prevent disease, improve diagnosis, and change behavior



SOURCE: American Diabetes Association; Ministry of Health, China; World Bank; McKinsey Global Institute analysis

Health-care products and services can help users be more aware of issues at an earlier stage to help them prevent illnesses from emerging or chronic conditions from deteriorating. Knowledge and remote monitoring can help people change their behavior and can trigger timely interventions when necessary. Evidence from outside China shows that these types of care models and incentive systems are likely to cut costs through self-management of disease and a reduction in the flow of patients to relatively expensive hospital beds.[220]

Area 2. AI-enabled care

AI-enabled digital solutions are another way for health-care providers to pursue more consistent and timely diagnosis and treat patients more directly and accurately.

Only **1 IN 5** dementia patients in China correctly diagnosed

A great deal of evidence shows that diagnosis is inadequate in China, that best practices in treatment are not being followed (and overtreatment is all too common), and that the quality of health care varies widely among regions and types of hospitals and clinics.[221]

[219] WeChat case studies (http://open.wechat.com/cgi-bin/newreadtemplate?t=overseas_open/cases).

[220] In Sweden, for instance, the Jonkoping Support Self Care of Sweden teaches patients with kidney failure to manage their own dialysis; this costs between 50 and 75 percent less per patient, with a reduction in side effects and infection rates. See *Global growth: Can productivity save the day in an aging world?* McKinsey Global Institute, January 2015.

[221] *Healthy China: Deepening health reform in China: Building high-quality and value-based service delivery*, policy summary, China Joint Study Partnership, 2016.

One study found that village doctors asked their patients only 18 percent of essential questions, correctly diagnosed just 26 percent of unstable angina cases, and dispensed medication that was either unnecessary or harmful in 64 percent of cases.[222] The China Association for Alzheimer's Disease reports that only one in five dementia patients affected is correctly diagnosed.[223]

Processes appear to be more effective in secondary and tertiary hospitals, but even here the evidence is limited or mixed.[224] There is also some evidence of large variations in patient outcomes in tertiary public hospitals.[225] Some studies find that a shortage of competent primary-care doctors and the generally low quality of primary care contributes to the increasing incidence of avoidable hospitalizations.[226] Patients in China report a poor attitude among doctors and nurses, a lack of effort, and short consultations.[227]

Studies paint a picture of human error and shortages of skilled professionals in Chinese health care. AI and machine learning can help improve the accuracy and consistency of diagnosis and treatment. AI can help traditional hospitals improve their productivity by providing better information for tailored diagnostics and treatment. At the same time, it can open up opportunities for digital players to enter the market by offering new services and can capture value from traditional health-care service providers. It can also help patients detect early signals of disease, improve wellness through personalized advice, and enable them to have more informed conversations with doctors that could improve treatment.

AI-based image recognition and machine learning can see far more detail than MRI or X-ray images that require interpretation by the human eye. Outside China, a number of companies have been developing AI solutions to improve the accuracy of scans.[228] In China, Baidu has launched an AI-powered conversational bot called Melody that provides information to physicians to help them make treatment recommendations. Beijing-based AI startup DeepCare specializes in medical imaging that helps increase the accuracy of cancer diagnosis.[229] iCarbonX, a biotech company based in Shenzhen, has partnered with technology companies around the world to gather health-care data that will be analyzed using algorithms and then used to enable customized health and medical advice delivered directly to consumers through an app.[230] LinkDoc of Beijing uses advanced algorithms to train computers to digitize and clean data from a range of oncology medical records,

[222] Sean Sylvia et al., "Survey using incognito standardized patients shows poor quality care in China's rural clinics," *Health Policy and Planning*, volume 30, issue 3, April 2015.

[223] Wang Xiaodong, "Illness often misdiagnosed in elderly," *China Daily*, November 22, 2016.

[224] One study found high uptake of secondary prevention of ischemic strokes in urban hospitals. See Jade W. Wei et al., "Secondary prevention of ischemic stroke in urban China," *Stroke*, volume 41, number 5, 2010. Failures to follow best practice have been found in the case of acute coronary conditions. See Yufang Bi et al., "Evidence-based medication use among Chinese patients with acute coronary syndromes at the time of hospital discharge and 1 year after hospitalization: Results from the Clinical Pathways for Acute Coronary Syndromes in China (CPACS) study, " *American Heart Journal*, volume 157, number 3, 2009.

[225] Y. Xu et al., Variations in quality of care at large public hospitals in Beijing, China: A condition-based outcome approach." *PLoS One*, 2015.

[226] See Jin Ma, *China's public hospital governance reform: Case study of Shanghai*, unpublished case study commissioned by the World Bank, 2015, cited in *Healthy China: Deepening health reform in China: Building high-quality and value-based service delivery*, policy summary, China Joint Study Partnership, 2016; and Lixin Jiang et al., "Achieving best outcomes for patients with cardiovascular disease in China by enhancing the quality of medical care and establishing a learning health-care system," *The Lancet*, volume 386, number 10002, 2015.

[227] *Healthy China: Deepening health reform in China: Building high-quality and value-based service delivery*, policy summary, China Joint Study Partnership, 2016.

[228] Moorfields Eye Hospital in London has teamed up with Google's DeepMind, and the Cleveland Clinic Lerner College of Medicine is collaborating with IBM Watson. See Bertalan Meskó, "Top artificial intelligence companies in healthcare to keep an eye on," MedicalFuturist.com, February 2, 2017. GE Healthcare and Alterys have together developed ViosWorks that uses an AI algorithm to improve and accelerate MRI scanning. See Drew Field, "See the heart in 7 dimensions: This team of researchers attacks world's biggest killer with software," GE Reports, December 3, 2015.

[229] DeepCare (https://www.crunchbase.com/organization/deepcare).

[230] David Cyranoski, "Chinese AI company plans to mine health data faster than rivals," *Nature*, January 20, 2017.

and then collates them in a database that health-care professionals can use to generate clinical insights into treatment outcomes. This could help in the treatment of lung cancer, which is prevalent in China. DXY, an online community of health-care professionals, and Xiangya hospital of Central South University are developing an AI solution to diagnose skin disease.[231]

Area 3. E-commerce

Just as e-commerce is revolutionizing consumer-facing businesses, so it can transform some aspects of health care, particularly insurance and drug distribution.

~180%
annual growth in digital channels in life insurance in China

In insurance, digitizing processes from sales to underwriting to reimbursements will mean that insurance agents can be disintermediated. New consumer behavior and new entrants are threatening traditional distribution channels. Policy holders are increasingly demanding digital-first distribution models in personal and small commercial lines, while aggregators are continuing to pilot insurance sales direct to consumers.[232] One UK insurer eliminated around 20 million calls per year by introducing an app that allowed customers to make direct changes to their policies.[233]

In China, the penetration of digital channels in insurance stood at only about 5 percent in 2016, but that is far higher than the less than 0.5 percent penetration observed in 2011; annual growth in the penetration of digital has been about 135 percent. In the case of life insurance, growth in digital channels has been about 180 percent a year. Ping An is moving toward digital in insurance through Ping An Direct, which was set up in 2014 and offers Chinese consumers financial services including life insurance through the internet, mobile, and social media. The Ping An Good Doctor mobile app helps customers to find the right doctor on its O2O platform (which has 50,000 doctors and over 3,000 hospitals), buy medications, and connect with health insurers. At no point is there any need for physical agents. Consumers seem to like this approach—customer satisfaction is at 98 percent, according to the company.[234]

Digital-enabled distribution of drugs and devices is relatively new and untested. Pharmaceutical and medical-technology companies can establish online direct-order platforms for patients and hospitals, disintermediating traditional distributors such as pharmacies and helping to reshape what is currently a fragmented market.[235] In China, recent policies allow more players to sell drugs on the internet, increasing efficiency. The number of licenses for internet drug sales stood at 913 in February 2017, compared with 517 in 2015.[236] The experience of online pharmaceutical sales suggests that regulators should focus on measures to keep consumers from gaining access to drugs without prescriptions and to clamp down on unethical operators selling substandard products.[237] The potential for

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231 "DXY has developed an AI solution to diagnose skin disease," *China News*, May 19, 2017 (http://www.chinanews.com/jk/2017/05-19/8228928.shtml).

232 *Making digital strategy a reality in insurance*, McKinsey & Company, September 2016.

233 *The making of a digital insurer: The path to enhanced profitability, lower costs and stronger customer loyalty*, McKinsey Financial Services Practice, March 2015.

234 For more detail, see, for example, *Ping An's strategy on health and medical business*, Ping An, December 2015; Oliver Wang, Ping An Good Doctor, December 2015; and Jennifer Li, "Ping An adds 10,000 China clinics to its health care business," *South China Morning Post*, November 7, 2016.

235 Elias Mossialos, Yanfeng Ge, Jia Hu, and Liejun Wang, *Pharmaceutical policy in China: Challenges and opportunities for reform*, 2016.

236 In 2004, the China Food and Drug Administration published new regulation to allow internet sales of over-the-counter drugs. More detailed regulation by the China Medical Pharmaceutical Material Association followed in 2016. Online drugs sellers need a license to provide drug-information services over the internet. See "Notice of the China Food and Drug Administration on strengthening the administration of internet drug sales" (http://en.pkulaw.cn/display.aspx?cgid=211917&lib=law); and "Health care e-commerce market will slow down in 2017," China Trade in Services, March 3, 2017 (http://tradeinservices.mofcom.gov.cn/e/2017-03-03/295587.shtml).

237 *China policies to promote local production of pharmaceutical products and protect public health*, European Commission and World Health Organization, 2017.

B2B sales of pharmaceuticals in China is huge given how many layers of transactions there are. The country recently introduced a "two-invoice system" that will reduce the number of steps it takes for hospitals to procure drugs from manufacturers, currently five to eight, to no more than two, significantly helping to reduce highly inflated drug prices.

Disaggregation can create health-care big data and improve the utilization of health-care resources

Disaggregation in health care centers on efforts to consolidate fragmented data and resources, and then monetize them by disaggregating them into services that offer improved diagnosis and treatment, improved access to patients, and higher utilization rates of facilities. Here we focus on health-care big data and sharing of resources.

Area 1. Health-care big data

~29%
of Chinese hospitals do not have electronic medical records systems

Medical data in China are currently segregated in data "islands" within each hospital or health-care institution. China also lacks standardized—and connected—medical records, which means that consolidating data and then using them to keep track of patients' needs, gain access to clinical information, and target the most appropriate treatments is highly challenging. There are three reasons for current inefficiencies. First, the degree of digitization is low. As of 2015, about 29 percent of hospitals in China had not installed electronic medical records systems (Stage 0 in the Himss Analytics Electronic Medical Record Adoption Model), compared with only 4 percent in the United States in 2014.[238] Second, connectivity between hospitals and even different departments within hospitals is limited. More than half of Chinese hospitals had not established intraclinical data repository health-information-exchange capabilities by 2014, compared with 6 percent in the United States (Stage 0 and 1). Only 21 percent of hospitals had established intrahospital electronic medical record connectivity (Stages 3 to 7), compared with 88 percent in the United States.[239] Third, hospitals have limited incentives to share their patient data with other hospitals and health-care companies, because doing so might affect their patient flow and financial performance.

Recognizing current challenges and the huge opportunities that better use of health-care data offer, in May 2017 the government announced plans to regulate for the first time how big data in the health-care sector are collected, stored, and used. [240]

Health-care big data could generate substantial value for players in the sector. Medical-technology and pharmaceutical companies could improve the productivity of their R&D and offer patients personalized drugs. By analyzing data, researchers can see what treatments are most effective for particular conditions, identify patterns related to drug side effects or hospital readmissions, and gain other important insights that can help patients and reduce costs. In addition, having more detailed and complete data on individual patients can make treatments more precise, lowering costs and ensuring superior outcomes at the same time. As data on an individual's health become more detailed—as the cost of genetic sequencing falls, for example, and sensors, monitors, and diagnostics provide a constant stream of real-time information—it becomes possible to customize treatments and interventions. The

[238] An electronic medical record is a digital version of traditional paper-based records for an individual, including, for example, medical history, diagnoses, medications, and allergies. An electronic health record is an official health record for an individual that is shared among multiple facilities and agencies and includes, for instance, medical history, vital signs, progress notes, diagnoses, medications, immunization dates, allergies, laboratory data, and imaging reports. Electronic health records can sometimes include health-insurance information, demographic data, and even data imported from personal wellness devices.

[239] This is based on the Electronic Medical Record Adoption Model published by Himss Analytics and China's EMR adoption model published by China's National Health and Family Planning Commission. Although there are nuanced differences between the two models, they share similar rating standards for measuring the adoption and utilization of electronic medical record functions. See EMRAM, Himss (http://www.himssanalytics.org/sites/himssanalytics/files/image/HIMSS%20Analytics%20EMRAM%20Criteria%20sheet.pdf); and *Healthy China 2030 Plan*, National Health and Family Planning Commission, August 25, 2016 (http://www.nhfpc.gov.cn/yzygj/s3593/201512/a335bd9490164b928f27276b0161daa9.shtml).

[240] *China's big data regulation to boost healthcare, security*, The State Council of the People's Republic of China, May 2, 2017.

use of such data for personalized medications, as well as the ability to deliver medications remotely, means that many more patients can be treated outside of the expensive hospital setting.

Health insurance and life insurance companies can substantially reduce waste from fraud and overtreatment due to information asymmetry. With big-data analytics, they can cross-check claims data with clinical data and analyze billing patterns, thereby helping to identify inappropriate payments. With better understanding of patients, companies can encourage behavioral changes that could cut the cost of insuring them. Zhong An Insurance, the first online-only insurer in China (and a joint venture of Alibaba, Tencent, and Ping An), is exploring the use of big data in its product development and claims management. Its special insurance program Tangxiaobei uses a connected glucose meter to monitor the blood sugar levels of patients with diabetes. Using this information, the company has designed a system of rewards and penalties for those it insures, which improves their compliance with treatment and therefore the outcome of that treatment.[241]

Many companies are exploring partnerships to maximize the benefits of health-care big data. AstraZeneca has formed a joint venture with the Beijing Institute of Big Data Research to exchange not only professional staff but also clinical databases. They also intend to collaborate on developing data analytics technology platforms for the diagnosis and treatment of diseases common in China.[242] Baidu is collaborating with the government of Beijing to build Baidu Cloud to monitor health big data from wearables and devices. Aliyun, also known as Alibaba Cloud, has partnered with Xi'an International Medical Investment and DHC Software to create a hospital-administration platform that the companies say will improve the quality of medical care by making it easier to manage individual patient cases and analyze aggregated health data.[243] Alibaba has also launched an end-to-end customer e-health app called Future Hospital that connects with about 200 hospitals in more than 20 provinces and 40 cities across China. It offers information in one place about what hospitals are available, appointment times, payments, and medical records.[244]

MGI research has found that personalizing medicine through the use of big data in health care globally could be worth $2 trillion to $10 trillion, depending on how rapidly health systems can adapt and whether R&D applications lead to breakthrough treatments. The opportunity is largest in economies that already have large pools of data.[245] In the United States, MGI research has found that the effective use of big data could reduce national health-care spending by more than $300 billion, or 12 percent of US health-care costs.[246]

Area 2. Shared resources

Another way that digital technologies can transform health care is by enabling the sharing of resources, including health-care professionals and specialized facilities such as independent clinical laboratories and ambulatory surgery centers. Not only does this save on cost, but it can also help address the fact that the use of health-care facilities is highly uneven.

Sharing physicians can help to overcome geographic imbalances in health-care provision (particularly urban vs. rural) as well as mismatches in care supply and demand. In this

241 *Product update of Doctor Tang*, Huanqiu, September 14, 2016 (http://tech.huanqiu.com/internet/2016-09/9441274.html).

242 *AstraZeneca formed a joint venture with the Beijing Institute of Big Data Research (BiBDR) to build healthcare big data lab*, Sohu, May 27, 2017 (https://mp.weixin.qq.com/s/C9559j1lilXmlXPGM6TzsA).

243 Catherine Shu, "Aliyun, an Alibaba unit, is building China's first 'cloud hospital,'" TechCrunch, April 20, 2015.

244 Scully Wan, "Alibaba's ambitious future hospital plan: Facilitating the current healthcare service in China," TechNode, May 30, 2014.

245 *The age of analytics: Competing in a data-driven world*, McKinsey Global Institute and McKinsey Analytics, December 2016.

246 *Big data: The next frontier for innovation, competition, and productivity*, McKinsey Global Institute, June 2011.

context, China's State Council proposed the idea of multisite practice in 2009. In April 2017, the National Health and Family Planning Commission implemented new regulations for the management and licensing of doctors that allow them to practice at an unlimited number of public and private facilities. The only stipulation is that doctors must be registered at the provincial level and report all the places they work to their primary employer.[247] These new rules are enabling the emergence of platforms—DXY is one of China's largest online health communities—where registered physicians can go to find available work opportunities and obtain training on policy, legal and relocation advice, and general career development.

Just as the shared economy model in real estate aggregates demand from a fragmented pool of consumers and significantly enhances the utilization of high-value fixed assets, digital health-care platforms can help match specialized facilities such as independent laboratories to a wide range of potential patients and achieve economies of scale. Demand for laboratory testing is increasing as clinical medicine develops rapidly, but technological, financial, and personnel limitations make it difficult for existing laboratories in China—even those at major hospitals—to meet rising demand. It is not cost-effective for a single hospital to conduct all the tests needed because of the high cost of buying and operating laboratory equipment and paying the specialists needed.[248]

Another type of facility that could adopt a sharing economy model is the independent ambulatory surgery center, which offers surgery but is not a hospital. Already well established in advanced economies, ambulatory surgical centers are now coming to China. In 2017, Yosemite opened China's first private center in Shanghai. Digital platforms can help match the facilities and services the centers provide with doctors and other potential partners, including hospitals and medical-technology and pharmaceutical companies.

Dematerialization is likely to have the smallest impact on health care

In health care, dematerialization is likely to have a relatively small impact compared with the other two digital forces. In the case of medical equipment, 3-D printing can produce implantable devices and customize drug texture and dosage to improve the quality of treatment. In 2016, Aprecia Pharmaceuticals gained approval from the US Food and Drug Administration to 3-D print a drug for the first time. Using ZipDose technology that allows pills to disintegrate in the mouth with only a small amount of water, Spritam is used for epilepsy patients.[249] In the longer term, it is possible that the bioprinting of living organs could become more widely used, but the future penetration of 3-D printing into health care is highly uncertain.

If similar forms of dematerialization take off and are more broadly adopted, companies sticking to traditional standardized manufacturing of medical devices and drugs could lose value to competitors embracing these technologies.

WHAT FUTURE CHINESE HEALTH CARE COULD LOOK LIKE IF ALL FORMS OF DIGITAL DISRUPTION RESTRUCTURED VALUE CHAINS SIMULTANEOUSLY

Around the world, health-care systems tend to be heavily regulated, barriers to entry are high, and change is slow. Many stakeholders, with varying incentives, interests, and attitudes toward change, are involved in this sector. But what would be the impact if all three types of digital disruption happened at the same time? We developed a big-bang scenario in which connected health-care delivery using IoT, AI-enabled health-care solutions, and fully functioning big data in health care all unfold in China. The change would be dramatic (Exhibit 28).

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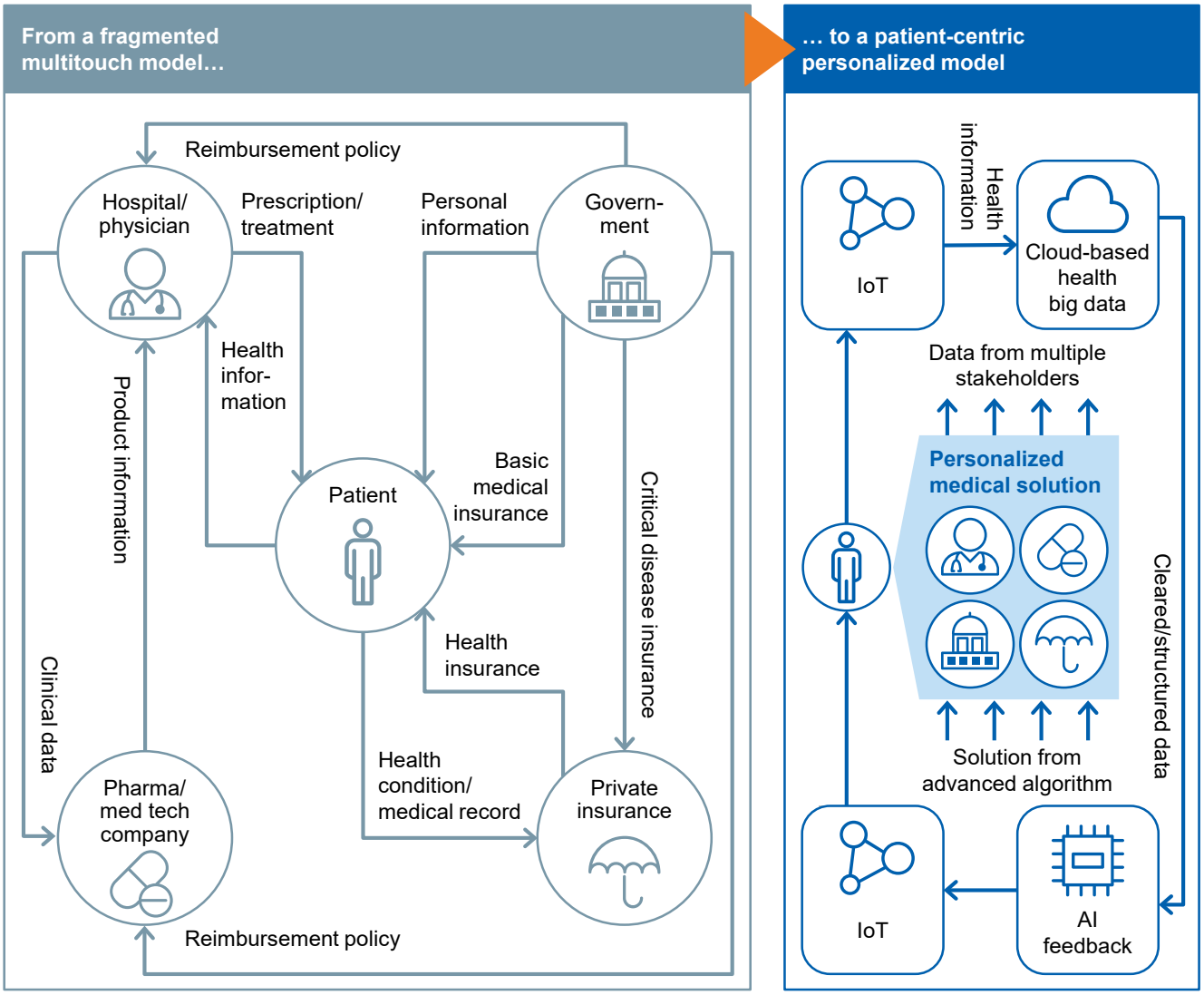
[247] Ni Dandan, *Multisite policy gives doctors a taste of private medicine*, Sixth Tone, June 30, 2017.

[248] Yaoming Liang, "Independent medical laboratories in China: A sunrise industry under the circumstances of healthcare reformation," *Asia Pacific Biotech News*, volume 16, number 6, June 2012.

[249] Jennifer Kite-Powell, "FDA approved 3D printed drug available in the US," *Forbes*, May 22, 2016.

Exhibit 28

In a big-bang scenario, the patient becomes the center of digital health care



SOURCE: McKinsey Global Institute analysis

China's health-care system is fragmented, with many touch points and stakeholders. Health-care providers, including hospitals, play the major role in making treatment decisions that have huge economic implications. Patients, who may lack the knowledge they need to make informed decisions, are passive in terms of their diagnosis, treatment, and how they pay. The result of this asymmetry is suboptimal decisions and wasted resources. In one study of 230,800 outpatient prescriptions in 28 Chinese cities, nearly half the prescriptions written between 2007 and 2009 were for antibiotics; 10 percent were for two or more antibiotics. This prescription rate was double that recommended by WHO. As a result, antibiotic resistance appears to be higher in China than in Western countries.[250] Fragmented information means that pharmaceutical and insurance companies and suppliers of medical technology deliver products and services that are generic and therefore not always suitable for the patient.

[250] Janet Currie, Wanchuan Lin, and Juanjuan Meng, *Addressing antibiotic abuse in China: An experimental audit study*, April 2014.

Nearly
1/2
of prescriptions in 2007–09 were for antibiotics

In our big-bang scenario, patients are at the center of the health-care system. They are well informed about drugs and treatment regimens because they are no longer at an informational disadvantage in relation to health-care providers. Data are collected from multiple sources, which enables players in the health-care system to track not only clinical information from hospitals but also behavioral and social information collected using IoT and digital devices. These data are constantly integrated; boundaries between data islands are broken down through seamless connections among all parts of the health-care system. The data are structured, stored in the cloud, and available to analyze. With machine-learning capabilities, AI processes massive data pools and extracts insights that facilitate improved decision making. Every patient touch point can be digitized, from "seeing" a specialist on an online consultation platform to filling a prescription at an e-pharmacy to tracking the delivery of drugs.

The result of this patient-centric, informed, and connected system is higher-quality outcomes. Patients receive personalized disease prevention and diagnosis as well as more consistent service. A wealth of data provides the evidence needed for quality and efficiency in the delivery of care. For instance, physicians can make highly accurate decisions on treatments and can predict the probability of disease incidence. Differences in capabilities between health-care professionals working in large and small hospitals and between experienced and new doctors are minimized. By collating an abundance of cases, big-data analytics can enable the standardization of clinical pathways. Even the least experienced physician in primary care can access and absorb an unprecedented wealth of knowledge. Data can also help drug companies develop better products.

How value might shift

Our big-bang scenario finds that the three forces could reduce China's overall health-care costs by the equivalent to up to 27 percent of current expenditure, and that the majority of savings would go to payors. Those savings should be reinvested in the system to boost the quality of services and improve access. Providers of digital solutions can capture additional value of up to 10 percent (Exhibit 29).

Payors are potentially the biggest winners because they control reimbursements. In our simulation, they can save the equivalent of 27 percent of health-care expenditure. They have the best visibility on the treatment of patients, compliance after treatment, and standard clinical pathways. A number of factors reduce the cost of reimbursement, including optimized patient flow, with more patients treated locally or at home, and less waste at large hospitals; improved use of medical resources; early diagnosis; and higher treatment quality. In a 2015 survey of more than 7,000 health-care providers, insurers, and health-care IT vendors by leading US market research company Black Book, 94 percent of respondents agreed that a hospital platform for information exchange would be viable for payors, compared with 33 percent of respondents who said that such platforms would be viable for hospital systems. More than 90 percent of respondents said that the payor would be the largest beneficiary.[251]

Big data in health care is likely to be positive for the health-care system as a whole. For large health-care providers that today receive a disproportionate share of all patient flows, there will be both positives and negatives. According to the China National Health and Family Planning Commission, about 2,100 Class III hospitals (large hospitals with more than 500 beds) account for 12 percent of all hospitals in China but, in 2015, handled more than 1.5 billion patients, or 52 percent of the national total. As we have noted, treatment enabled by IoT and AI could lead to a reduced flow of patients to large hospitals. Moreover, the greater transparency enabled by such technologies could reduce the level of overtreatment

[251] *State of the enterprise Health Information Exchange Industry, Black Book Market Research 2015 User Survey*, 2015.

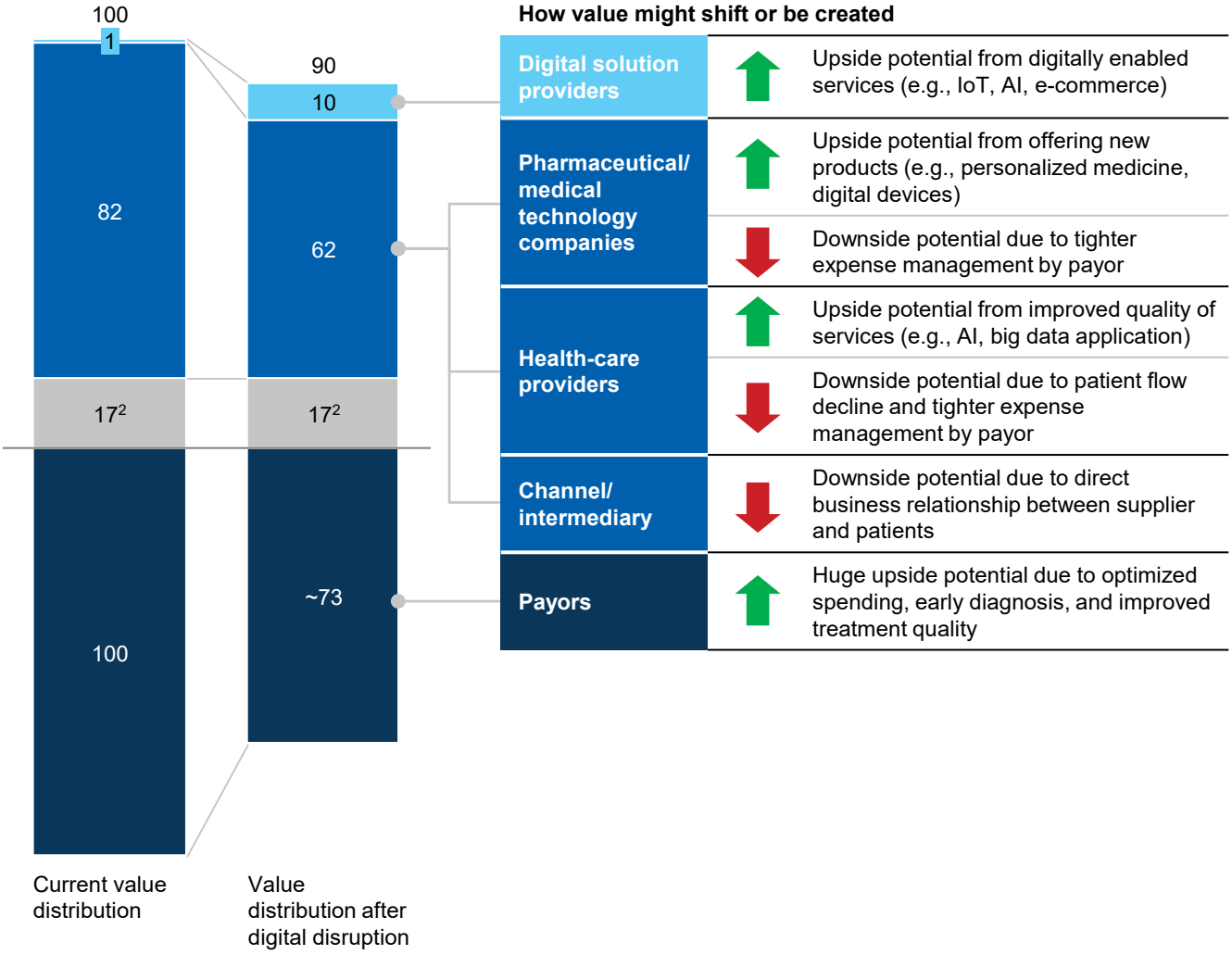
and overprescription, putting pressure on the finances of large hospitals. On a positive note, however, these technologies can relieve the pressure on overcommitted doctors and other staff in large hospitals. AI-enabled solutions can help doctors to improve their skills. They can also help to direct flows of patients to small and medium-sized hospitals, improve the quality of treatment, help doctors to be more mobile, and make more information available through big data analytics.

Exhibit 29

Digital forces can shift (and create) value among stakeholders in health care

HIGH SCENARIO[1]

Big-bang value redistribution among health-care stakeholders
Value as % of original payor expenditure


100
1
82
17²
100
90
10
62
17²
~73
How value might shift or be created
Digital solution providers
Upside potential from digitally enabled services (e.g., IoT, AI, e-commerce)
Pharmaceutical/ medical technology companies
Upside potential from offering new products (e.g., personalized medicine, digital devices)
Downside potential due to tighter expense management by payor
Health-care providers
Upside potential from improved quality of services (e.g., AI, big data application)
Downside potential due to patient flow decline and tighter expense management by payor
Channel/ intermediary
Downside potential due to direct business relationship between supplier and patients
Payors
Huge upside potential due to optimized spending, early diagnosis, and improved treatment quality
Current value distribution
Value distribution after digital disruption

1 The simulation assumes the same coverage of patient and disease as today. The total health-care expenditure in the future will continue to increase as the demand on health care services rises and the support from government expands.
2 Includes primarily government investment in infrastructure, R&D, and others. We assumed it remains unchanged in our simulation.
NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

Pharmaceutical and medical-technology companies may experience both gains and losses in value. Gains can come from new business opportunities such as personalized medication services, big data-enabled R&D, and value-added services such as rehabilitation. Losses could come as patients receive more precise treatment, reducing overtreatment and waste.

Drug distributors and pharmacies are likely to lose value as waste in drug prescription and treatment is reduced. Drug-distribution companies and insurance agents are likely to be disintermediated as patients gain direct access to pharmaceuticals, medical-technology devices, and insurance companies.

Providers of digital solutions can benefit from the digitization of health care as long as they offer disruptive business models—models that, for instance, provide information-exchange platforms and deliver health-care services directly to patients enabled by IoT and AI. In our big-bang scenario, we estimate that these players could capture value equivalent to about 10 percent of health-care expenditure.

WHETHER AND WHEN DISRUPTION WILL OCCUR DEPENDS ON A NUMBER OF FACTORS

All of the forms of disruption that we have discussed can potentially occur, but predicting how they will play out is difficult. Several factors are worth watching.

- **Will the necessary regulatory framework and sufficient incentives to create health-care big data materialize?** Players that control big data in health care will have a huge competitive advantage, and competition for that ownership could be intense. But the full benefit of big data for the health-care system as a whole can be unleashed only if silos are broken down and the data are shared openly. Previous MGI research has found that $300 billion to $450 billion of annual value could be unlocked in the US health-care system alone through open data.[252] Appropriate regulation and incentives to ensure that this happens need to be put in place. Natural owners of big data in health care are large hospital groups, but they may not have sufficient incentives to share data with other players. The volume of patients they treat and the revenue they make may decline as a result of less overtreatment. Patients not only need to overcome their concerns about privacy to share data on their health, but recognize that doing so will improve the quality of their treatment.[253]

  A great deal of hype surrounds China's digital and mobile health care, which is not surprising given the hundreds, if not thousands, of apps and digital solutions that have appeared in recent years. However, these digital solutions affect only the periphery of health care—tasks such as making appointments, arranging mobile payments, and building online communities. A large share of health-care services in China continues to be delivered through state-owned hospitals that are not far along in their digitization journeys, and therefore the available data are currently insufficient to offer disruptive innovations at the core of the health-care system.

- **Will the health-care system pay for digital solutions?** Although the technology is available, most companies developing today's digital health applications lack proof that their apps produce long-term improvement in users' health—and, indeed, that patients are prepared to use them regularly, thereby creating an economic benefit to the health-care system. This lack of evidence means that health-care systems may be reluctant to invest in these technologies. But it is health-care systems that have the ability and expertise to gather the necessary proof from the data they collect as they measure patients' changing health over time. What could incentivize health-care systems to use their data to support the case for digital solutions?[254] China is making some bold steps

[252] *Open data: Unlocking innovation and performance with liquid information*, McKinsey Global Institute, McKinsey Center for Government, and McKinsey Business Technology Office, October 2013. Also see *The "big data" revolution in health care: Accelerating value and innovation*, McKinsey Center for US Health System Reform and McKinsey Business Technology Office, January 2013.

[253] In the United States, the Health Insurance Portability and Accountability Act regulates the security and disclosure of personal health information by health insurers, medical care providers, and other entities.

[254] *How healthcare systems can become digital-health leaders*, McKinsey & Company, January 2016.

in this area. Neusoft, a leading IT solution and service provider, opened a cloud-based hospital in Ningbo to serve patients with chronic diseases. Ningbo Cloud hospital has more than 1,000 contract doctors and 13 online clinics. It can process medical payment reimbursement through social insurance with the assistance of the municipal government. [255]

- **Will technology continue to advance?** To power the digitization of health care requires continuous development in data analytics, IoT, and AI technologies. But even if these advances happen, the data produced by health-care systems are highly complex and difficult to share and structure in a manner that enables the technologies to play their full part. In theory, it makes perfect sense to combine multiple sources of data—clinical data from hospitals, claims data from insurance companies, behavioral data from patients, and R&D data from pharmaceutical and medical-technology companies, for example. But the accompanying challenges are huge.[256] A health-care sector is made up of many individual systems that generate their own data, which may not be compatible with data from other sources. Amalgamating such disparate streams of data is highly complex and requires a far more sophisticated set of tools than in, say, the manufacturing industry. Integrating behavioral data from IoT devices and mobile platforms adds even more complexity to data analytics. Digital companies in China are attempting to create usable big data using their superapps, tracking everyday footprints and e-commerce and building relatively extensive health profiles for each user. The latest smart big data platform from Baidu provides solutions that can be applied in health care.[257] If China's major digital players expand their cloud and big data-processing capabilities en masse into health care, this may unlock sufficient data to make its processing affordable. Ensuring access to usable data is vital for the development of AI in health care.

- **Will health-care professionals and patients accept behavioral changes?** If all the parts of the puzzle were to fit together and create a big-bang digitization in health care, the system would be transformed. From a largely reactive system that treats patients once they become ill would emerge a system that centers on patients, prevention, and self-management. Much will depend on a change in attitude not only among health-care service providers but also among individuals.[258] Doctors are highly trained specialists who may be resistant to their judgment being supplanted or even augmented by digital tools powered by data from millions of other cases. Patients would need to learn to trust AI-enabled doctors and recommendations from IoT devices, and change their daily habits. To persuade them to adopt new ways of thinking and managing their health care will also require a broad improvement in quality. In China, there is a deep-rooted perception that only large urban hospitals offer competent health care, and therefore people tend to queue up to be seen at these busy centers even for non-serious conditions. One survey found that 68 percent of patients did not trust community hospitals to give them high-quality care.[259]

[255] *Neusoft seeks to enter new markets 2½ years after launch of China's first cloud hospital*, Yicai Global, March 24, 2017.

[256] *The age of analytics: Competing in a data-driven world*, McKinsey Global Institute and McKinsey Analytics, December 2016.

[257] "Here's why Baidu is strengthening its computer offering," *Forbes*, July 18, 2016.

[258] Sundiatu Dixon-Fyle, Shonu Gandhi, Thomas Pellathy, and Angela Spatharou, "Changing patient behaviour: The next frontier in healthcare value," *Health International*, McKinsey Healthcare Systems and Services Practice, 2012.

[259] "How to realize hierarchical diagnosis and treatment," *China Youth News*, April 15, 2014 (http://zqb.cyol.com/html/2014-04/15/nw.D110000zgqnb_20140415_2-07.htm).

FREIGHT AND LOGISTICS: FASTER AND CHEAPER

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Logistics cost in China

16%

of GDP in 2015, vs.

8%

in the United States

China's rapid economic growth has powered robust expansion in the freight and logistics industry in recent decades. The middle class has expanded, consumption has grown, production of goods has increased, e-commerce volumes have exploded, and the flow of goods around the country—and the world—has soared. China has become the world's largest goods-trading nation. Trade in goods grew at 5.3 percent a year between 2010 and 2016 to hit the $4.4 trillion mark.[260] During that period, the Chinese logistics industry grew at a rate of 14 percent a year, according to the National Statistics Bureau. Delivery of goods has accelerated. Express delivery volumes in China increased at double-digit rates every year between 2010 and 2015.

However, China's traditional freight and logistics sector has faced significant challenges. The cost of logistics as a percentage of GDP was 16 percent in 2015, compared with 8 percent in the United States and 9 to 10 percent in the EU. Higher costs in China reflect the industry's inefficiencies, a result of the fragmentation of the sector, operational shortcomings, and relatively limited competition in certain sector segments where SOEs are strong. There are large variations and different types of inefficiency among different parts of this sector (see Box 8, "Four main types of carrier by transportation mode and three types of service provider"). In segments where SOEs dominate, such as rail, airlines, and ocean shipping, change is happening slowly. However, in private-led sectors such as road transport and express delivery, the speed of change has been rapid and experimentation with new digital solutions has been active in recent years.

The inefficiencies in the sector offer opportunities to reshape value chains and boost productivity, with considerable benefits for customers, companies, and the economy.

- **Freight and logistics customers.** Customers can obtain more efficient and cheaper services. Direct digital channels can disintermediate middlemen in freight matching, and therefore offer lower prices to customers. More transparency around price quotations and the availability of service providers (such as consigners and truck drivers) would lead to better matching of logistics orders demand and supply. Use of express delivery, for example, reduced the unit price of delivery by 50 percent between 2005 and 2015, according to Aliresearch.[261] Customers can also obtain higher-quality service. The application of real-time matching and optimal route planning can lead to goods being delivered more quickly and with less loss and damage. State Postal Bureau statistics from June 2017 show that about 95 percent of complaints from express-delivery customer complaints relate to delays, damage, loss, and unsatisfactory delivery quality.[262] Digitally enabled track and trace tools on customer apps can give consumers much better visibility of where their goods are.

- **Freight and logistics companies.** Companies can improve operational efficiency. Digital platforms can optimize the flow of regional freight by matching inbound and outbound delivery, which can improve utilization of trucks (by keeping them from traveling empty when they go back to their original locations) and thereby lower costs. Improved tools to predict demand and match it to real-time supply not only improve the utilization of containers and warehouses, but also lead to more market-sensitive pricing for freight (charging more for a truck if the company knows it is in high demand on a particular day, for instance). There are also opportunities to experiment with new business models and cater to underserved customers. E-forwarding services can be offered to serve small and medium-sized shippers that are often overlooked by large forwarders. Using autonomous driving in road transportation and crowdsourcing

[260] *Digital globalization: The new era of global flows*, McKinsey Global Institute, March 2016.

[261] *Three future trends in the e-commerce logistics industry*, Aliresearch, May 12, 2016 (http://www.aliresearch.com/blog/article/detail/id/20931.html).

[262] *Notifications* of consumer complaints in the mail business, State Post Bureau, July 13, 2017 (http://www.gov.cn/xinwen/2017-07/13/content_5210126.htm).

in last-mile delivery can generate savings on labor costs and compensate for loss and damages.

- **The economy.** Digital solutions can help transform this highly fragmented and inefficient sector into one that is more integrated and coordinated, eliminating unprofitable and inefficient players and creating innovative business models. In its 13th Five-Year Plan, the government expressed an aspiration to develop more diversified freight and logistics services to support further urbanization and private consumption. In the plan, it envisages encouraging companies to develop new ways of working in areas such as information sharing and the integration of resources; setting up cross-border e-commerce free-trade zones; and encouraging high-quality players in the sector with integrated logistics credit ratings.[263] All of these efforts could potentially lower logistics costs and increase the efficiency of logistics flows from urban to rural areas.

[263] *13th Five-Year Plan for the trade and logistics industry*, Ministry of Commerce, February 8, 2017 (http://www.mofcom.gov.cn/article/guihua/201702/20170202511705.shtml).

Box 8. Four main types of carrier by transportation mode and three types of service provider

The freight and logistics industry is multifaceted. One way of looking at the sector is by transportation mode.

- **Road transportation.** Road transportation is the ground shipping of cargo to airports or shipping ports, and then to final destinations. Companies in this business work closely with air, shipping, road, and rail operators.[1] Road transportation is the largest mode of freight transportation in China and the biggest employer. In 2016, there were around 33 billion tons of freight traffic, much higher than the figures for water, rail, and air cargo combined. Road transportation employed around 30 million people, or about 11 percent of the total labor force. This is a highly fragmented business made up of some eight million registered trucking companies.[2] More than one-third of these companies are owner-operated—in other words, small businesses, including one-man operations.[3] The efficiency of road transportation is hampered by low truck utilization and by the fact that there are many fragmented connection points between port terminals, highways, and warehouses.
- **Ocean shipping.** This is the second-largest type of freight transportation. China has the world's largest container ports—in 2015, the World Shipping Council ranked Shanghai's and Shenzhen's first and third in the world, respectively, in throughput volume. SOEs are strong in this subsector, which is highly concentrated. The top ten players command about 80 percent of the market. Inefficiencies come from a number of sources, including the continued prevalence of paper-based customs clearance, the fragmentation of road transportation, and dependence on third-party providers such as forwarding companies.

[1] Typically, cargo is divided into two categories. Full truckload carriers move freight that is loaded into a semi-trailer, typically of between 26 feet (7.9 meters) and 53 feet (16.2 meters). Less than truckload or less than load shipping is the transportation of relatively small freight, apart from parcel carriers or full truckload carriers. Parcel carriers usually handle small packages and freight that can be broken down into units of less than 150 pounds (68 kilograms).

[2] *2017 Annual report of China Road Transport Association*, CRTA, May 12, 2016 (http://www.crta.org.cn/article-2349.html).

[3] Rachel Katz, "Long-haul China," *McKinsey Quarterly*, June 2013.

Box 8. Four main types of carrier by transportation mode and three types of service provider (continued)

- **Rail cargo.** The third-largest type of freight is rail. In 2016, rail carried three billion tons of freight. This subsector, too, is largely state-owned, and is dominated by the China Railway Corporation, which is closely supervised by the Ministry of Transport. Rail freight is grappling with inefficiencies such as a lack of granular pricing and with operational challenges such as limited intermodal solutions from rail to port (on-dock rail connections, for instance). However, there have been moves to rectify this situation, including action to simplify cargo-handling procedures, and the introduction of rail-courier services and on-request door-to-door services.[4]
- **Air cargo.** China has the world's second-largest air-freight market after the United States, with volume of about seven million tons in 2016. Nevertheless, this is still the smallest of the four freight transportation modes. With cross-border e-commerce increasing, there is an imperative to raise the efficiency of air-cargo operations. Three state-owned airlines, which command more than 50 percent of the market, dominate the subsector. Competition is lacking, efficiency is low, and return on capital is relatively weak.

Another way to look at the sector is by the type of service provided. We highlight three types.

- **Express delivery.** Express delivery is one of the fastest-growing segments of the freight and logistics industry. The subsector grew by 20 percent a year between 2000 and 2015 to stand at $45 billion. The leading players are private-sector companies, including SF Express and Deppon. Competition is intense as companies vie to serve increasingly demanding e-commerce giants such as Alibaba and JD.com. The key focus for express-delivery companies is shortening delivery times, increasing the frequency of deliveries, and boosting operational efficiency in order to offer lower prices.
- **Freight forwarding.** Traditional forwarders are experts in logistics networks, assisting shippers to contract with one or more carriers to move goods to market. Freight-forwarding companies organize shipments for individuals or corporations, transferring goods from producers to end customers. Among the activities undertaken are the preparation and processing of paperwork for clearing customs, proof of delivery, bills of lading, and other documentation and related activities. The key value created by freight forwarders to their customers is information flow. In 2015, the industry was valued at around $30 billion. It is highly fragmented in China, which has more than 50,000 forwarding companies.[5] Information asymmetries and inefficient matching of shipments account for huge variations in pricing.
- **Contract logistics.** Contract-logistics players handle outsourced resource-management tasks such as designing and planning supply chains, designing facilities, warehousing, transporting and distributing goods, processing orders, collecting payments, managing inventory, and even providing certain aspects of customer service. In China, this industry was valued at around $80 billion in 2015, more than double the size of the freight-forwarding segment. Like freight forwarding, this segment is inefficient because it is highly fragmented and suffers from information asymmetry in real-time supply-chain matching and pricing.

[4] *Logistics industry in China*, Fung Business Intelligence Centre, August 2013.

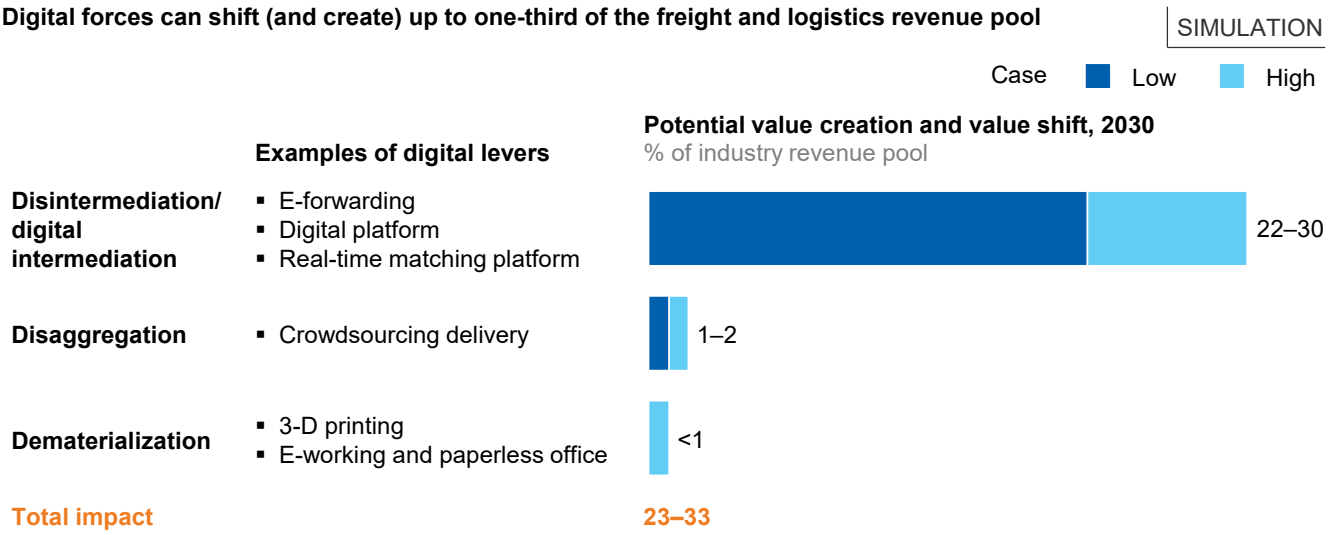
[5] *Freight forwarding and logistics industry develops smoothly*, China Trade in Services, August 10, 2017 (http://tradeinservices.mofcom.gov.cn/g/2017-08-10/336924.shtml).

BY RESTRUCTURING VALUE CHAINS, DIGITIZATION CAN POTENTIALLY SHIFT (AND CREATE) UP TO 33 PERCENT OF THE INDUSTRY'S REVENUE POOL

Our simulation finds that digitization can shift and create value equivalent to between 23 and 33 percent of the industry's revenue pool. Disintermediation (or digital intermediation) through e-forwarding in ocean shipping and establishing direct channels in road transportation and express delivery is the digital force with the largest potential impact, shifting or creating between 22 and 33 percent. In express delivery, disaggregation through crowdsourcing and sharing of data on supply chains can shift or create value equivalent to between 1 and 2 percent of the industry revenue pool (3 and 11 percent of the express-delivery revenue pool). Dematerialization through 3-D printing, e-working, and paperless solutions can reduce the flow of shipments, which could potentially affect about 1 percent of the industry revenue pool (Exhibit 30). The technologies that can be deployed in freight and logistics are highly interrelated throughout the value chain; they include quotations of delivery prices, pickup of goods, line haul (the movement of cargo between two major cities or ports), warehousing until it is time to deliver goods, and delivery to customers.

Exhibit 30

Digital forces can shift (and create) up to one-third of the freight and logistics revenue pool



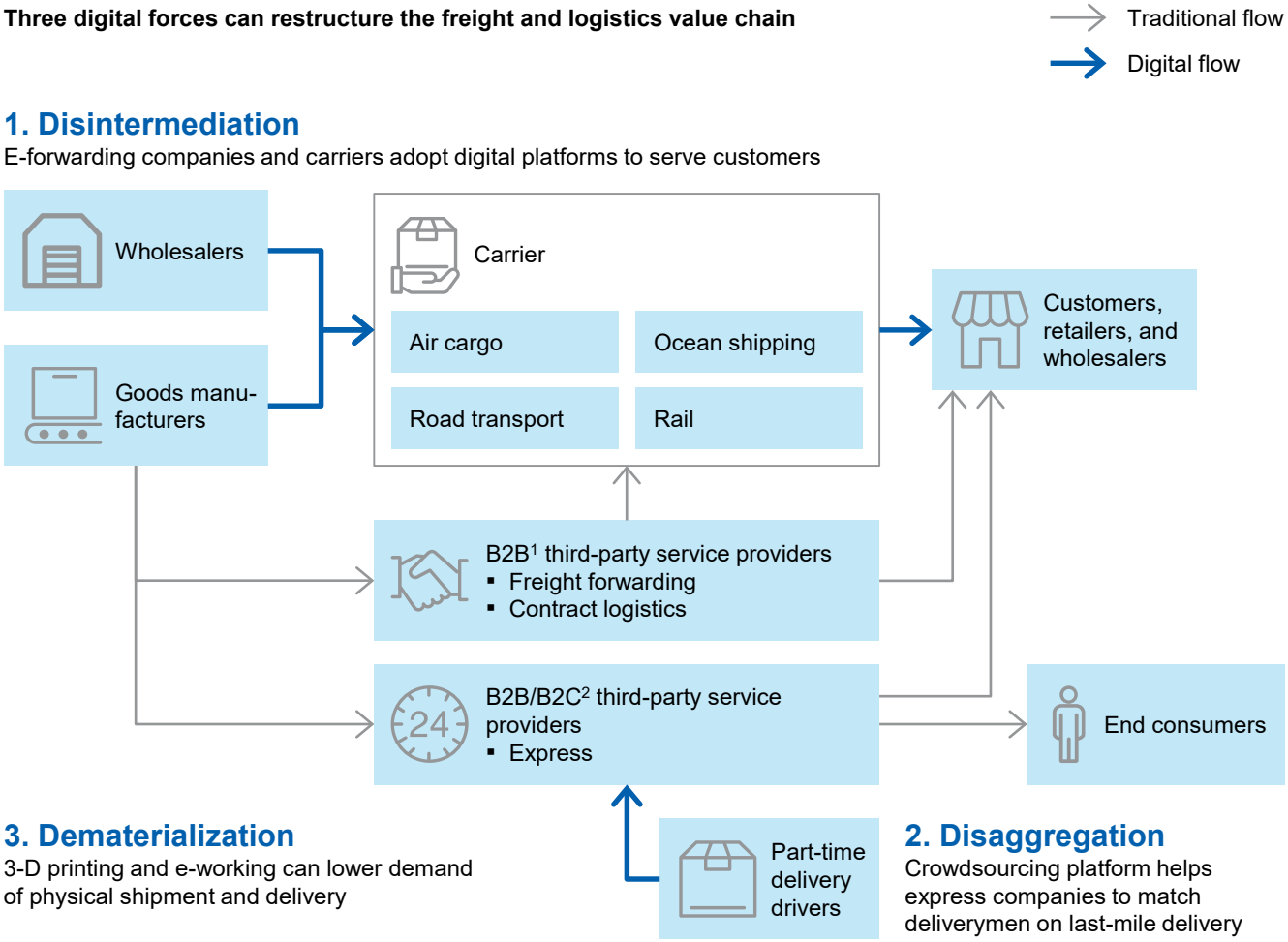
NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

To assess the impact of digital forces in the freight and logistics industry, we analyzed around 70 use cases and focused on three subsectors: ocean shipping (disintermediation), road transportation (also disintermediation), and express delivery (both disintermediation and disaggregation) (Exhibit 31). Together, they are valued at around $570 billion and account for three-quarters of the freight and logistics market; all are highly inefficient and underutilized. The express-delivery market is much smaller, at around $45 billion, but is the fastest-growing subsector.

Exhibit 31

Three digital forces can restructure the freight and logistics value chain



1 B2B = business-to-business.
2 B2C = business-to-consumer.

SOURCE: McKinsey Global Institute analysis

OCEAN FORWARDING: DIGITALLY DRIVEN DISINTERMEDIATION CAN BETTER MEET UNDERSERVED CUSTOMERS' NEEDS

Today, rough estimates suggest that about 70 percent of ocean forwarding businesses serve small and medium-sized enterprises (SMEs), but many of these companies are underserved by existing service providers. Leading forwarding companies tend to provide dedicated sales and service teams and tailor-made logistics including instant price quotations, and to offer price discounts, only to large customers. The fact that traditional forwarders are not serving the majority of customers in this sector leaves them vulnerable to competition from e-forwarders that do serve SMEs as well as from carriers that provide direct solutions through digital and analytics platforms.

Companies using digital means can outcompete traditional forwarders on efficiency and price in two key ways. The first is data-driven information and booking platforms, which offer transparency on prices and markets. Today, prices are opaque and therefore subject to huge variations. For example, in mid-December 2016 the prices the top 20 carriers charged on the busy Shanghai to Long Beach, California, route varied by more than 30 percent.[264]

[264] Zvi Schreiber, *Transparency and overcapacity: Where freight is going in 2017*, Supply Chain Brief, 2017.

Some pioneering digital freight-forwarding platforms such as Yunquna in China have reduced their international logistic costs by as much as 20 percent by using the platforms.[265]

In the United States and Europe, specialized e-forwarders, incumbent carriers, and e-commerce players are moving to use these platforms. One type of e-forwarding largely creates improved transparency on rates, products, and availability of services, instantly matching demand and supply; one example is online freight marketplace Freightos, a Hong Kong-based startup. Another type of e-forwarding offers value-added services such as information on the status of shipments through the use of tracking and tracing. For instance, Dublin-based Fleetmatics offers web-based and mobile application solutions that provide fleet operators with information on vehicles' location, speed, mileage, and fuel usage.

In China, e-forwarders are disrupting traditional forwarding companies by offering competitive and more advanced services to customers. US company Flexport is a freight forwarding and customs brokerage firm; it offers a web-based app that gives visibility in real time on trans-Pacific trade lanes and shipments across China, Europe, and the United States, and offers port-to-port value-added services targeted at smaller shippers. JC Trans Group, a carrier in China, offers e-forwarding functionality through JCTrans.com; the company is the China Logistics Industry Association's top ranked business-to-business logistics website, with more than 300,000 registered members and more than 1.5 million daily visits.[266] E-forwarders including Flexport and Myhuodai offer value-added services such as online matching and real-time status updating to make headway in this underserved segment.

The second digital approach that can disrupt the sector is carriers' direct or omnichannel approaches. Carriers can build platforms themselves or collaborate with others. This approach can give them direct access to customers with real-time matching of shipments to overcome the many logistical breakpoints in the transportation of goods from port terminal to warehouse, for instance, and at competitive prices. Leading container transportation and shipping companies are launching initiatives to digitize their front-end customer interfaces and offer real-time rates for shipping services, 24/7 online support, online quoting and booking services, and shipment data—all without the need for intermediaries. French company CMA CGM has partnered with Alibaba for container space, and its customers can book shipments online using Alibaba's One Touch Platform.[267]

How value might shift

Our simulation suggests that e-forwarding platforms or carriers can capture value from traditional forwarders. E-forwarders can penetrate underserved SME segments by offering competitive and transparent prices as well as advanced services such as online booking and real-time tracking and tracing of shipments through their digital platforms. Carriers can build their own digital platforms and disintermediate traditional forwarders by offering a similar value proposition to end customers. Carriers can also use the advantage of massive data and advanced analytics in demand forecasting to improve operational aspects such as load factors. Digital platforms can directly connect shippers to trucking platforms, which can offer real-time matching, improving end-to-end visibility. Consumers should also benefit. With improved transparency and efficiency, international experience suggests that customers can capture the benefits of lower pricing.

[265] Company website (http://www.yunquna.com/anli.html\0).

[266] Company websites.

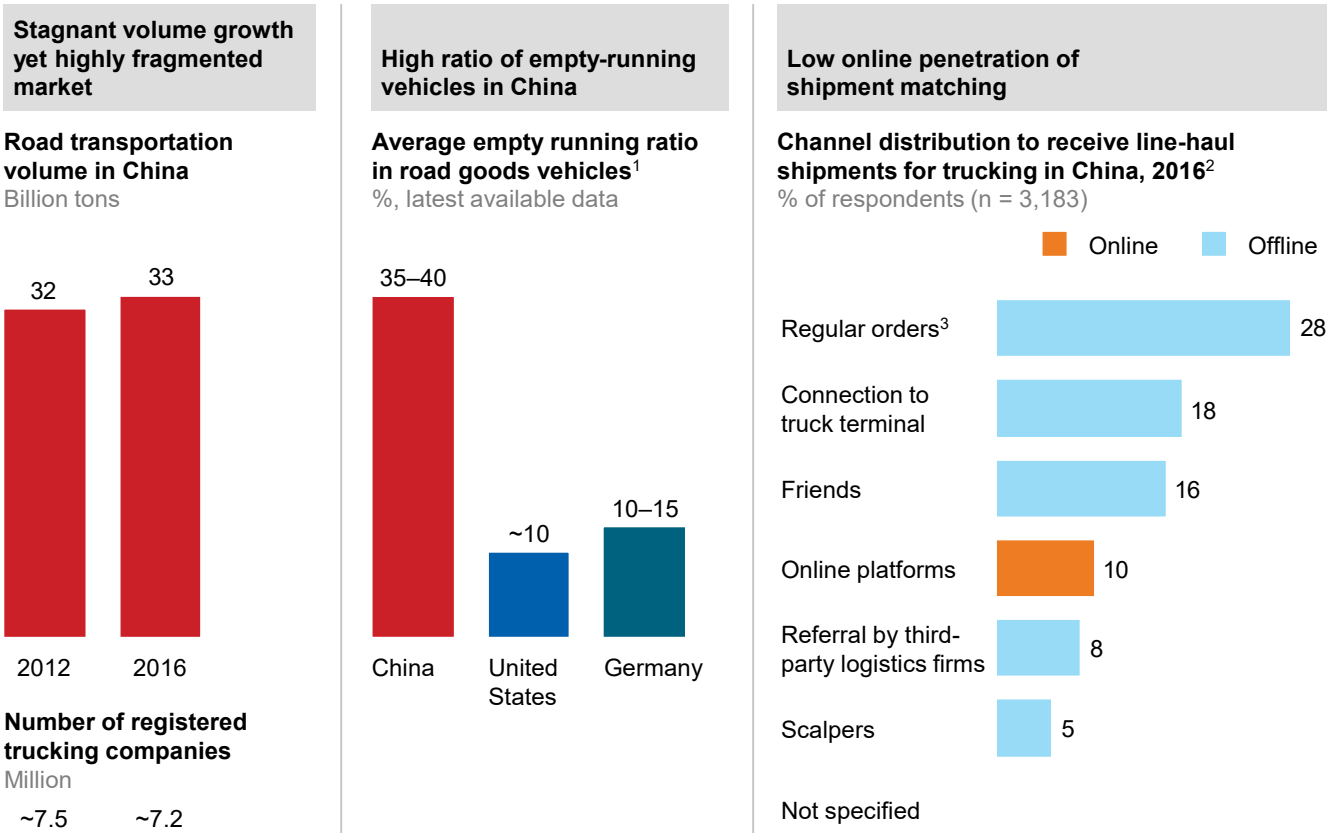
[267] *Signature of a digital cooperation between CMA CGM and Alibaba One Touch*, CMA CGM press release, February 14, 2017.

ROAD TRANSPORTATION: DIGITAL DISINTERMEDIATION CAN ADDRESS FRAGMENTATION AND UTILIZATION CHALLENGES

Road transportation faces substantial challenges in China (Exhibit 32). Although volumes grew consistently by 6 percent a year between 2012 and 2016, this subsector remains highly fragmented. About 95 percent of China's estimated eight million registered trucking companies and individual truckers are small and medium-sized concerns rather than large-scale, professional container-truck fleet companies. Less than 1 percent of companies in this subsector have 50 trucks or more in their fleets.[268] Managing freight transit with so many self-employed and small enterprises is not easy.

Exhibit 32

Digital solutions can address market fragmentation and utilization challenges in road transportation



1 Empty running is calculated as the percentage of total vehicle kilometers when the vehicle is empty.
2 Channel distribution based on a March 2016 survey by the China Federation of Logistics and Purchasing (sample size is up to 3,183 trucking company owners or truckers).
3 Regular orders mainly from consignees, trucking companies, and transshipment hubs.

SOURCE: China Road Transport Association; China Federation of Logistics and Purchasing; Fung Business Intelligence; Analysis; McKinsey Global Institute analysis

Another challenge is the fact that participants in this sector lack transparent, real-time information on routing, which leads to a high number of trips by empty trucks. In China, the average empty running ratio in road transportation is about 40 percent, far higher than the 10 to 15 percent average in the United States and Germany. Last but not least, penetration of online shipment matching is low in China's road-transportation sector. Most truck drivers are not highly educated, and, according to the China Federation of Logistics and Purchasing, 90 percent of them normally use offline channels to obtain business. They tend to rely on regular orders from consignees, trucking companies, and transshipment hubs,

[268] *Transportation statistics bulletin of the China Road Transport Association*, CRTA, May 12, 2016 (http://www.crta.org.cn/article-2349.html).

or to wait for connections at truck terminals, which can take a long time. Given that only 10 percent of truck drivers obtain orders online, there is a great deal of upside.

Only **10%** of truck drivers in China obtain orders online

Scope for online platforms to disrupt this business is clearly high because of a combination of factors. They include very high service requirements in lead times and quality from corporate clients that have strong bargaining power, and the presence of many complicated processes, particularly in long-distance trips between distribution centers, truck terminals in rural areas, and city depots. These processes include, for instance, route planning, cargo consolidation and loading, and unloading planning for goods of irregular shapes. Service charges are not standardized and therefore mostly negotiable, which creates opaque pricing.[269]

Real-time online matching platforms that connect business users with truck companies or individuals have enormous power to disintermediate small traditional trucking companies. Typical O2O truck-matching platforms connect logistics companies and truck terminals, offer prompt cargo information to registered users, line up consigners, agents, and truckers, and assist in arranging payment for services rendered. More than 200 truck-matching platforms have been launched in China since 2013, according to one study.[270] One of these is Ymm56, which offers real-time matching in trucking services and integrates receipts, loans, and other financial services into its offering; the company has 850,000 registered shippers and three million heavy truck drivers on its platform. Yihuodi, which was launched by Transfar Group in 2016, provides less-than-truckload shippers and truck drivers with a free mobile app, which enables them to match scattered shipments with available trucks. The company also offers its customers warehousing and inventory management.

How value might shift

Companies running digital platforms are likely to gain share from traditional trucking companies. They can eliminate information asymmetries, enable the sharing of idle or empty truck capacity, and provide value-added services such as real-time matching and instant price quotations. The fragmented and inefficient market structure, dominated by small and medium-sized trucking companies, could be consolidated. Even in Europe and the United States, where the logistics industry is more modernized than in China, there was significant market consolidation in 2007 when market conditions deteriorated. By 2008, more than 2,000 European trucking companies operating fleets of five or fewer trucks went bankrupt. In the United States, thousands of trucking firms, most of them with 25 or fewer trucks, went under.[271] In China, the rise of leading online platforms can spur similar consolidation, eliminating unprofitable and inefficient small-sized truckers.

EXPRESS DELIVERY: DISINTERMEDIATION AND DISAGGREGATION CAN OPTIMIZE INDUSTRY OPERATIONS AND SHORTEN DELIVERY TIMES

Express delivery tends to cover small packages and parcels over relatively short distances and is known, as its name suggests, for the speed of delivery. The “last mile” portion of delivery—the final and usually most expensive stretch of a package’s journey from a warehouse to the final customer—has become increasingly important as shoppers demand cheaper and faster delivery. In China, e-commerce giants such as Alibaba and JD.com require short last-mile-delivery times, high reliability, and good service quality without loss and damages, and this has propelled express delivery to explosive growth.

[269] Winnie Lo, *E-commerce reshaping line haul delivery*, Fung Business Intelligence, June 2017.

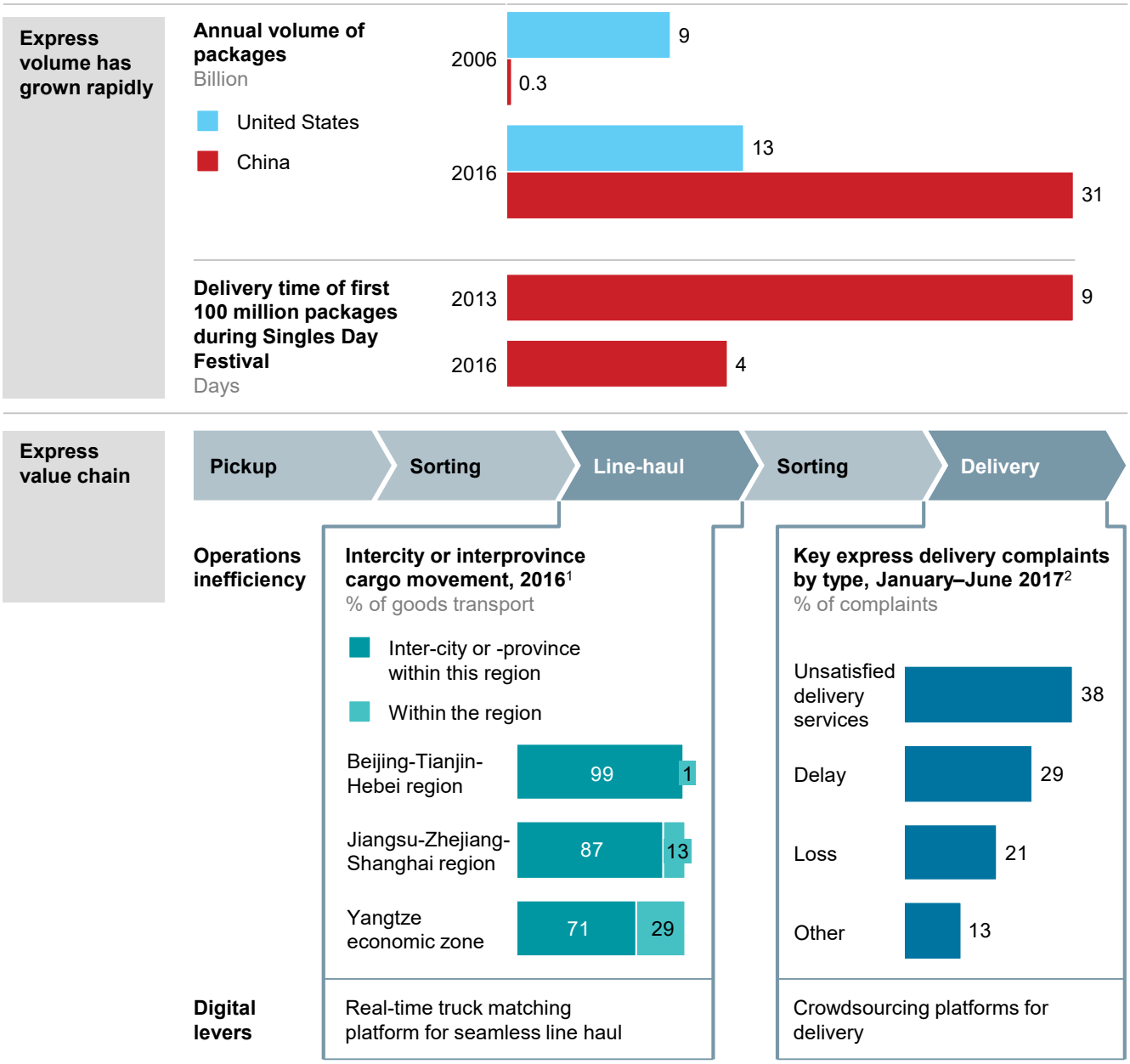
[270] Ibid.

[271] Pilar Londoño-Kent, *Freight transport for development toolkit: Road freight*, World Bank and the (UK) Department for International Development, 2009.

The annual volume of express delivery in China soared to 31 billion packages in 2016 from 0.3 billion only a decade earlier, and is now more than double that of the United States. In addition, delivery times are expected to be shorter than before. Huge volumes and demanding customers mean that express-delivery companies have an imperative to continue to improve performance (Exhibit 33).

Exhibit 33

Digital solutions can address challenges in the line-haul and delivery segments of the express value chain



1 Based on e-commerce intercity or interprovince goods transport data from Aliresearch for 2016.
2 Express delivery complaints statistics received by China State Postal Bureau: unsatisfied delivery services include delivery frequency, delivery time limits, notification to customers, etc. Others include damages and mispricing.

SOURCE: China State Postal Bureau; China Federation of Logistics and Purchasing; Fung Business Intelligence; Global Smart Logistics Submit 2017; Aliresearch; Pitney Bowes; McKinsey Global Institute analysis

China's express-delivery industry faces major challenges in line-haul and last-mile delivery. In line haul, one of the key difficulties is transporting billions of packages across cities and provinces in the short time that customers demand. According to Aliresearch, at least 70 percent of packages in China must go through intercity or interprovince cargo routes in the three major economic clusters. For example, 71 percent of goods transported within the Yangtze economic zone are from other regions or destined for other regions. In the Beijing-Tianjin-Hebei and Jiangsu-Zhejiang-Shanghai regions, the shares that come from elsewhere or are going elsewhere are even higher at 99 percent and 87 percent, respectively. Another difficulty is that there are not enough delivery drivers to meet customers' expectations of delivery frequency and speed, which can cause delays. According to the China State Postal Bureau, 25 percent of intercity express delivery did not meet the on-time delivery target. Delivery personnel are scattered across China but are still expected to fulfill last-mile delivery orders with very short lead times (sometimes within one day). The bottom line is that the number of express packages has been growing faster than the number of people available to deliver them. So there is pressure on express-delivery companies either to hire more workers or to make their business models more efficient.

Digital solutions can help. By matching supply and demand in real time with algorithms, online matching platforms can shorten the time that customers have to wait as well as increase capacity utilization of carriers by matching trucks with freight on their return trip or using drone delivery to save the cost of delivery drivers. Large e-commerce players including Cainiao, Luoji, and Huochebang have supported the development of several real-time matching platforms. Backed by Alibaba and a number of sizable express-delivery companies, Cainiao has developed a cross-company big-data platform connected to many express-delivery partners, including SF Express, ZTO Express, and Yunda. The platform can handle activities from booking orders to digital delivery. This enables the company to process nine trillion lines of information per day and mobilize 1.7 million express-delivery drivers in its network in a safe, secure, and cost-effective manner. The platform offers predictive demand analysis and a radar alert system to distribution centers in more than 600 major cities and 50,000 express-delivery points. In the case of the shopping bonanza of Singles Day, the number of days it takes to deliver 100 million packages has fallen from 9.0 in 2013 to only 3.5 in 2016.[272]

Another digital solution is crowdsourcing delivery. This is an effective way to meet the need for delivery drivers, which is not always easy, particularly in large cities, where demand is so strong and unpredictable, especially during promotions. Moreover, as labor costs rise, it is even more important for express-delivery companies or e-commerce delivery units to be efficient and flexible in their deployment of drivers. In the United States, Amazon launched its Amazon Flex platform to form a network of independent delivery contractors to fulfill orders in more than 30 US cities.[273] DHL has tested a crowdsourcing delivery solution called MyWay largely using students in Stockholm; an app shows customers the status of parcel deliveries.[274] In China, there are also now platforms that crowdsource delivery drivers, including Dada, Shensong, and Fengniao Delivery. JD.com launched its own delivery network—JD Daojia—to provide consumers two-hour last-mile delivery services in 2015. The unit later merged with Dada, which had more than 1.3 million crowdsourced delivery staff members in 37 cities.[275]

[272] Aliresearch and Global Smart Logistics Summit 2017, Aliresearch, May 22, 2017 (http://i.aliresearch.com/img/20170522/20170522100820.pdf).

[273] Company website (https://flex.amazon.com/about).

[274] *DHL crowd sources deliveries in Stockholm with MyWays*, DHL press release, September 3, 2013.

[275] *JD Daojia and Dada to merge, forming highly integrated O2O platform*, JD.com press release, April 15, 2016.

How value might shift

Traditional express-delivery companies are likely to lose part of their revenue to line-haul truck real-time-matching platforms instead of owning their own fleets. In contrast, providers of digital solutions are likely to gain as they disintermediate express-delivery companies with these platforms. By using crowdsourcing platforms, express companies can make more delivery drivers available and increase their capacity.

DEMATERIALIZATION: VIRTUALIZE PRODUCTION AND TRANSACTION PROCESSES TO SUBSTITUTE FOR FREIGHT AND LOGISTICS

Potentially, 3-D printing, e-working, and paperless offices can speed up design, production, and internal processes and reduce the flow of goods domestically and globally, thereby reducing demand for freight and logistics in both sending and receiving countries. China exported 13.8 trillion renminbi ($2.1 trillion) of goods and imported 10.5 trillion renminbi ($1.6 trillion) in 2016, which together was equivalent to about 34 percent of GDP, according to China's National Statistics Bureau.

McKinsey has found that 3-D printing can create structural change if there is a significant substitution effect in the flow of traded goods. In an extreme scenario, if 3-D printing can produce customized goods such as sportswear, luxury bags and toys, and industrial spare parts for advanced industries and heavy manufacturing, it would reduce imports and exports and therefore demand for container throughput, freight forwarding, and even road transportation (and reduce exports if other countries were to adopt 3-D printing and reduce their imports from China).

The same logic could apply to paperless processes. An estimated 40 percent of postal delivery consists of paper-based documents such as letters and magazines.[276] Some sectors today remain paper-heavy, including social services, financial services, and logistics for customs clearance. Digital information systems including digital certificates could substantially reduce demand for paper, the need to deliver it, and importation of it into China. In 2015, China imported three billion tons of pulp paper and related raw materials, or about 1 percent of import values, according to the National Statistics Bureau.[277]

How value might shift

If a certain share of international freight were to be replaced by 3-D–printed goods and services, and digital solutions such as e-working and paperless offices penetrated further, this could reduce physical freight and logistics demand by about 1 percent, our simulation suggests. However, companies offering 3-D printing and automation software could capture new market opportunities.

[276] *The operation of the postal industry*, State Post Bureau, December 15, 2016 (http://www.spb.gov.cn/dtxx_15079/201612/t20161215_933410.html).

[277] *Strategic choices for banks in the digital age*, McKinsey & Company, January 2015.

WHETHER AND WHEN DISRUPTION WILL OCCUR DEPENDS ON A NUMBER OF FACTORS

As in the other sectors we have discussed, all three digital forces may play out, but the extent and timing are uncertain. Several factors could have an influence.

- **Can digital solutions be implemented cost-effectively?** E-forwarding platforms already offer transparent market information and value-added services such as real-time quotes and booking freight capacity for SMEs without significant technical difficulties. However, there are still implementation challenges, such as collecting inaccurate and unstructured data, difficulties integrating fragmented cargo information, and problems with tracking service quality and validating drivers' delivery service. Digital solutions need to overcome these issues in order to offer enhanced convenience and be cost-competitive. For instance, algorithms and analytics need to make e-forwarding and real-time matching platforms sufficiently fast and cheap to persuade SMEs to shift from traditional forwarders.

- **Will customers adopt new types of services?** Many companies, including startups, are testing business models for e-forwarding platforms and crowdsourcing, but some elements must still be put in place to ensure large-scale adoption by users.[278] Delivery drivers appear eager to work on a crowdsourced basis, but customers and consumers may not trust people recruited this way, who therefore may not be certified. For large-scale adoption, companies will need to train crowdsourced delivery people to the same standard as their own in-house full-time delivery force.[279]

- **Will the regulatory framework support change?** In order to address structural inefficiencies and fragmentation, it will be important to create an environment for companies to grow and achieve economies of scale. The government has taken several steps to support the development of the logistics industry, but the implementation of policy has sometimes hindered growth. The way licenses are handled is an example. Logistics companies have to apply for various types of operating licenses to set up nationwide businesses. Provincial governments issue the licenses, and charges vary among provinces. Because they have to deal with so many sets of regulators, some logistics companies find it hard to develop interregional business. Many local governments also impose requirements on logistics operations, such as strict rules on in-town trucking in consideration of urban traffic control and the environment, and fixed quotas for the number of in-town trucking licenses issued. Logistics operators that do not obtain licenses may have to pay more to hire licensed firms or risk being fined for operating without a license. In addition to these considerations, there may be restrictions on loading zones or on the type of trucks allowed into towns.[280] Broadly, it is important for regulators to create a helpful business environment to encourage more private-sector investment in the industry.

[278] *Technological disruption and innovation in last-mile delivery*, Stanford Graduate School of Business white paper, June 2016.

[279] Bien Perez, "JD.com in US$200m merger with China's largest crowdsourcing delivery platform," *South China Morning Post*, April 15, 2016.

[280] *Logistics industry in China*, Fung Business Intelligence Centre, August 2013.

HIGHER PRODUCTIVITY THROUGH DIGITAL OPERATIONS

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Digital could boost productivity by

3–14%

of industry revenue

Digitization provides opportunities for companies, especially large incumbents, to improve their efficiency. They can use digital tools to boost revenue and optimize cost. For Chinese companies, a significant opportunity exists to adopt best practices and to use the strengths of China's digital ecosystem.[281]

- **Revenue improvement.** Digital levers can help companies enhance revenue. They can influence consumers along their decision journeys through precise marketing and advanced analytics, and thereby trigger new demand. They can maximize revenue potential through efficient product development using digital simulation and price optimization, and can improve customer satisfaction through targeted customer-relationship management and loyalty-management programs.

- **Cost optimization.** Digital levers can help companies optimize their cost structures. They can save on materials costs through digital procurement; on manufacturing costs through predictive maintenance and smart energy management; and on supply-chain costs through smart inventory management and by optimizing delivery routes using advanced analytics.

Adopting these levers and digitizing business operations is an obvious and necessary move for many businesses as the competitive threat from failing to ride the digitization wave, and the investment needed, rises. MGI has extensively researched the role digital has to play in enhancing productivity.[282] Here, we briefly describe opportunities relevant to the four sectors highlighted in this research, focusing on revenue and cost. Overall, our simulation suggests that the productivity impact could be 3 to 14 percent of the industry revenue pools of these four sectors. We note that this may not necessarily translate into impact on the bottom line, as a significant share could be passed on to customers and consumers as a result of enhanced market competition.

CONSUMER AND RETAIL: DIGITIZATION CAN CREATE IMPACT EQUIVALENT TO 3 TO 10 PERCENT OF THE INDUSTRY REVENUE POOL

The potential impact of digital transformation for consumer-goods companies and retailers is significant. We estimate that the adoption of digital solutions could improve productivity by the equivalent of 3 to 10 percent of the industry's revenue pool (Exhibit 34).

[281] China accounts for about 25 percent of the world's manufacturing activity, more than any other country on earth, but has productivity only one-fifth that of developed economies. Embedding automation and data into manufacturing is clearly an opportunity. However, in June 2016, a McKinsey survey of 130 companies found that Chinese manufacturers say they are less prepared than their counterparts in other countries. Notably, only 44 percent of respondents from SOEs said that they were prepared. See Forest Hou, Arthur Wang, and Ting Wu, "A digital upgrade for Chinese manufacturing," *McKinsey Quarterly*, May 2017.

[282] See, for instance, *The age of analytics: Competing in a data-driven world*, McKinsey Global Institute and McKinsey Analytics, December 2016; *A future that works: Automation, employment, and productivity*, January 2017; *China's choice: Capturing the $5 trillion productivity opportunity*, June 2016; *The Internet of Things: Mapping the value beyond the hype*, McKinsey Global Institute, June 2015; *China's digital transformation: The internet's impact on productivity and growth*, July 2014; and *Big data: The next frontier for innovation, competition, and productivity*, 2011.

Exhibit 34

Digital levers can create an impact equivalent to 3 to 10 percent of the consumer and retail industry's revenue pool through productivity enhancement

Case
Low
High
Top productivity improvement levers
Potential impact, 2030
% of industry revenue pool
Description
Smart customer relationship management (CRM)
0.1–2.4
Add sensor data and real-time responses to conventional CRM
Big data–enabled inventory optimization
0.6–2.2
Use IoT and big data analytics to monitor and decide the optimal level of inventory
Self-checkout and automated store operations
0.6–1.4
Use IoT technology to fully automate checkout and store operations to reduce labor cost and enhance efficiency
Real-time personalized promotions
0.4–1.2
Combine historical preferences and in-store data to generate real-time and customized in-store promotions
After-sales service improvements
0.1–0.9
Adopt digital technologies to improve consumer's after-sales experience (e.g., condition-based maintenance)
Layout optimization
0.4–0.7
Study the location and movement of shoppers to optimize layout
Digitized supply chain and logistics
0.1–0.5
Use IoT and big data to improve efficiency of supply-chain management and logistics (e.g., track and trace)
Real-time monitoring and control of production
0.1–0.2
Optimize factory operation through real-time monitoring and control of production lines
IoT-enabled health and safety management
~0.1
Use IoT to monitor the health and safety of manufacturing workers to reduce injury/illness and improve productivity
Predictive maintenance
~0.1
Determine when maintenance will be needed through digital monitoring to reduce routine maintenance costs
Total impact
3–10

NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

For consumer-goods companies, big-data analytics and smart customer relationship management employed to make tailored recommendations can provide revenue upside and enable real-time responses to consumers' needs. Digital solutions can also raise productivity by reducing costs. Using IoT and big-data analytics to monitor and then decide on the optimal level of inventory and to reduce waste can potentially generate 20 to 50 percent savings on the cost of inventory management by using best practices. Companies can also improve the management of factory operations with real-time monitoring and control that can potentially reduce operating costs by 10 to 25 percent. Using predictive maintenance can also improve the health and safety of the workforce.

Digital solutions not only offer benefits to online players, but can transform the performance of offline retailers. In terms of revenue, combining real-time personalized in-store promotions that draw on data about customers' historical preferences, coupled with smart customer relationship management, can increase the number of transactions completed while customers are visiting a store and increase sales by as much as 11 percent in certain categories. There are also a number of ways to reduce cost. Offline retailers can use digital means to know their customers better, and therefore waste less money on discounts, promotions, and marketing to customers they should not be targeting. Digital technologies can also improve the after-sales experience for customers, and therefore potentially increase follow-up spending. Self-checkout technologies, which are now spreading through supermarkets in some Western and emerging countries, can reduce the number of checkout staff by as much as three-quarters and reduce customers' waiting time by 40 to 80 percent.[283]

AUTOMOTIVE AND MOBILITY: DIGITIZATION CAN CREATE IMPACT EQUIVALENT TO 5 TO 14 PERCENT OF THE INDUSTRY REVENUE POOL

We have identified a number of key digital levers across the value chain in China's automotive and mobility sector that could boost productivity by 5 to 14 percent of the industry revenue pool (Exhibit 35).

20–50%
labor cost reduction potential from advanced robots in smart manufacturing

In manufacturing, the impact comes from three main areas: customized R&D, digitization of supply chains, and smart manufacturing. In the first area, "digital twins"—a virtual tool that simulates physical objects on a near-real-time basis—can continuously collect data and signals from vehicles that can then be used to improve the productivity of new products. Digital supply chains will also have a major effect. Given that procurement typically costs 55 to 60 percent of OEMs' revenue, and logistics costs account for an additional 5 percent of revenue, digital supply-chain levers can generate significant impact. For example, real-time supply-chain and capacity optimization can potentially lower the cost of managing inventories. Digital procurement, including digitized analysis and online orders, can streamline processes and potentially reduce procurement costs. In logistics, digital route optimization and online-delivery platforms can potentially cut costs.

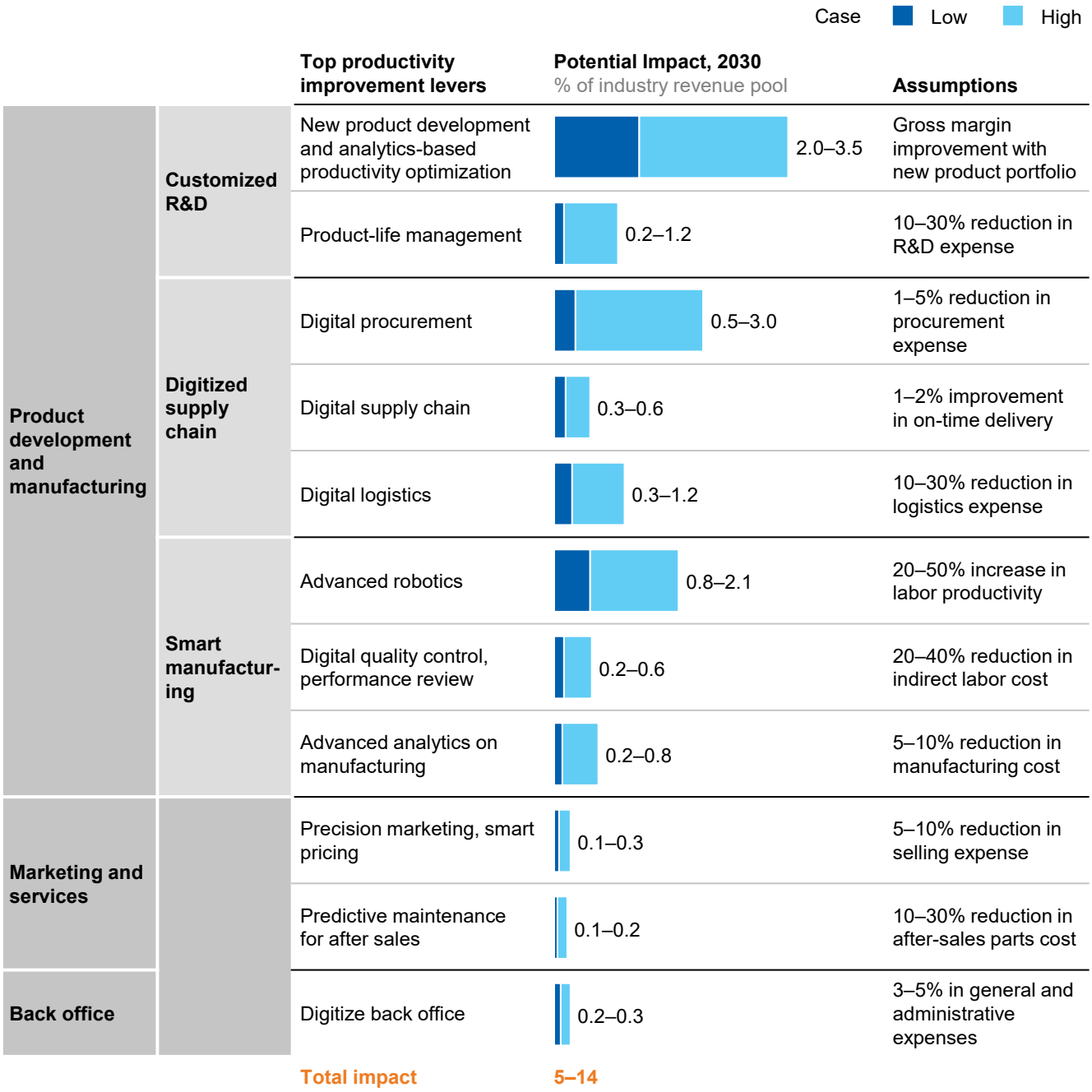
In smart manufacturing, advanced robotics is the largest lever for higher productivity. Advanced robots can increase labor efficiency and therefore potentially reduce labor costs by between 20 and 50 percent. Digitized quality management could save 20 to 40 percent on the indirect cost of labor, while advanced analytics can shave 5 to 10 percent off the cost of manufacturing.

In marketing and services, precision marketing and smart pricing enable companies to focus on targeted customer segments, potentially saving 5 to 10 percent on the cost of selling. We estimate that predictive maintenance can save 10 to 30 percent on the cost of after-sales services. In the back office, digitizing the human resources and IT functions could potentially lower general and administrative expenses by 3 to 5 percent.

[283] *The Internet of Things: Mapping the value beyond the hype*, McKinsey Global Institute, June 2015.

Exhibit 35

Digital levers can create an impact equivalent to 5 to 14 percent of the automotive and mobility industry's revenue pool through productivity enhancement



NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

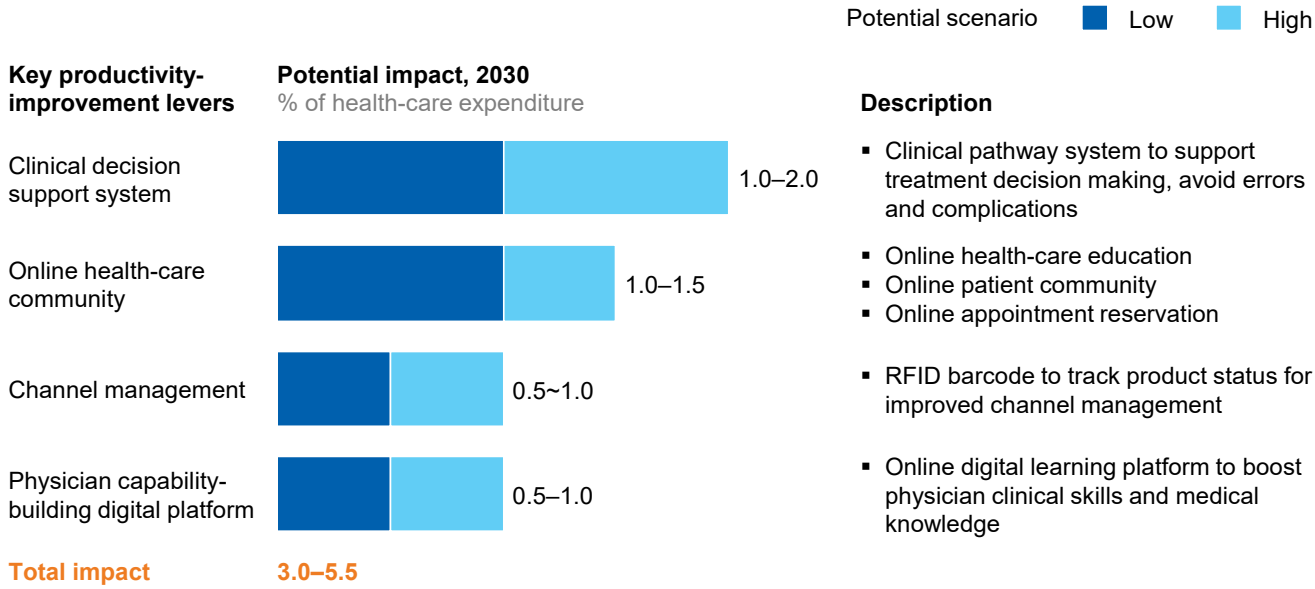
HEALTH CARE: DIGITIZATION CAN CREATE IMPACT EQUIVALENT TO 3.0 TO 5.5 PERCENT OF SPENDING

In China (and many other countries around the world), the population is aging. This, in combination with rising incomes in China, is fueling demand for more and higher-quality health care. It is therefore important to identify levers that can raise productivity and minimize waste—money that can then be reinvested in the system.

In China, we find that digital levers can help companies save the equivalent of 3.0 to 5.5 percent of health-care expenditure (Exhibit 36). One of the major levers is the use of clinical decision support systems that rely on standardized norms of care. China's government requires all Class 3 hospitals and 80 percent of Class 2 hospitals to participate in clinical pathway programs.[284] The current generation of clinical decision support systems analyzes orders from physicians and compares them with standardized medical guidelines in order to reveal potential clinical errors and thereby reduce the potential for liability claims. Such systems could reduce health-care expenditure by 1 to 2 percent.

Exhibit 36

Digital levers can create an impact equivalent to 3.0 to 5.5 percent of health-care expenditure through productivity enhancement



NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

Developing health-care communities and information sharing is another key driver of productivity. Rating and review platforms that publish information about clinical practices and the results of treatment save patients time searching for the best health-care providers and cut costs by helping them to home in on the most appropriate care. They also act as a mechanism forcing providers to offer cost-effective and high-quality treatment. Online health communities can also help citizens improve the management of their own health. These communities can potentially reduce health-care expenditure by 1.0 to 1.5 percent.

[284] Clinical pathways or care maps use evidence-based practice to reduce the variability of care in health-care systems and standardize treatments to ensure uniform quality.

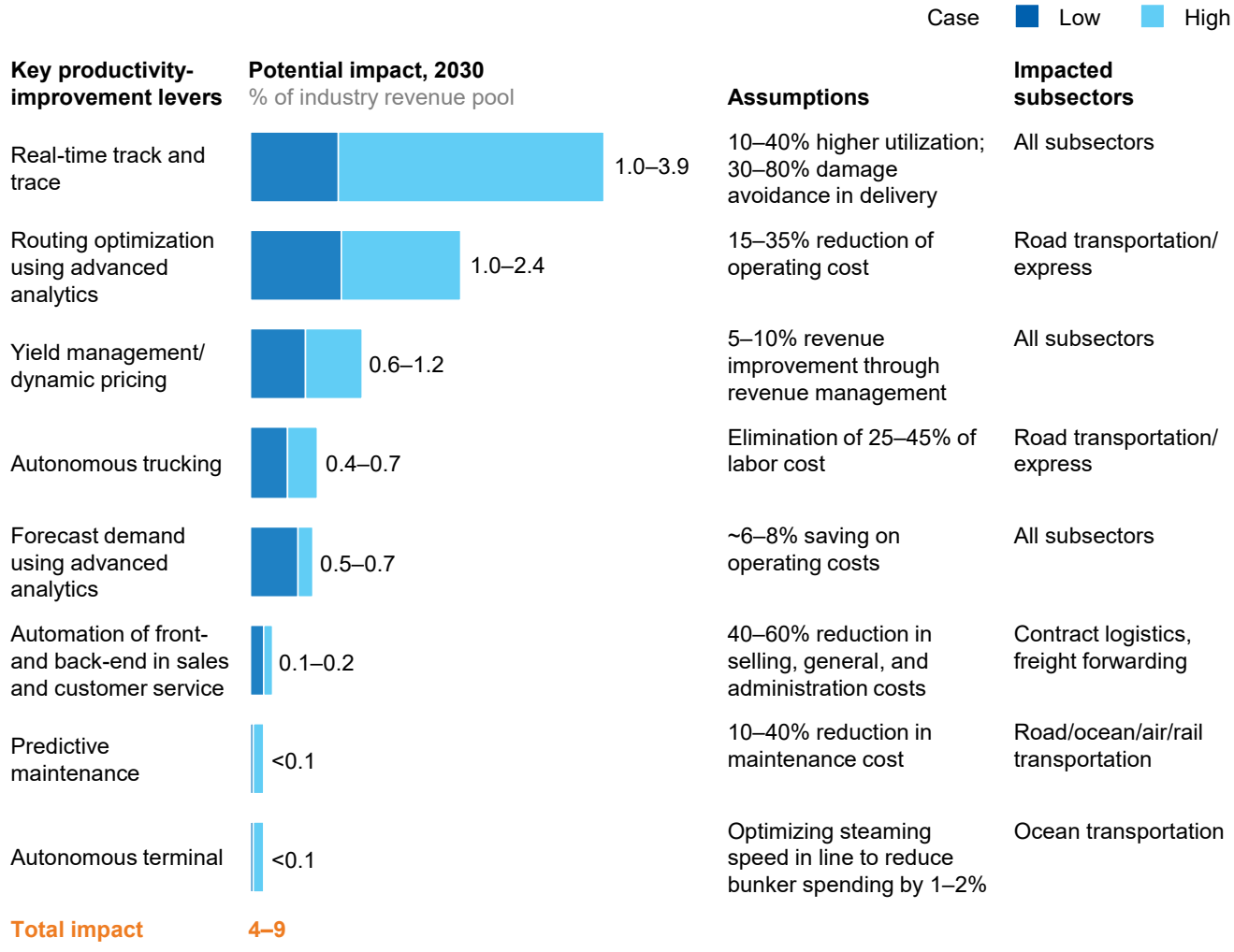
Operational improvements enabled by digital technologies include, for instance, the use of radio-frequency identification technology in the pharmaceutical industry to optimize the efficiency of supply chains and to reduce fraud. Data gathered by sensors can then be used to analyze market dynamics, channel behavior, and customer needs, potentially saving about 0.5 to 1.0 percent of health-care spending. Online digital learning platforms that develop physicians' capabilities can save an additional 0.5 to 1 percent.

FREIGHT AND LOGISTICS: DIGITIZATION CAN CREATE IMPACT EQUIVALENT TO 4 TO 9 PERCENT OF THE INDUSTRY REVENUE POOL

Earnings before interest and taxation in the freight and logistics sector in China are low, at around 2 to 5 percent, because of structural inefficiencies, gaps in operations, and increasing competitive pressure. Digitization could boost the productivity of the sector by 4 to 9 percent of the industry revenue pool (Exhibit 37).

Exhibit 37

Digital levers can create an impact equivalent to 4 to 9 percent of the freight and logistics industry's revenue pool through productivity enhancement



NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

Real-time tracking and tracing can be applied to all forms of freight, reducing downtime as well as losses and damage. If Chinese players were to implement international best practices, they could improve the utilization of containers by 10 to 40 percent and reduce damage during delivery. Optimizing routing using advanced analysis can be applied to road freight and logistics and express delivery, and potentially generate improvements in operating efficiency of between 15 and 35 percent.[285] Yield management and dynamic pricing can potentially generate an additional 5 to 10 percent of revenue. Autonomous trucking could potentially reduce labor costs by an estimated 25 to 45 percent if commercially and technically viable solutions emerge. Today, about 7.2 million trucks and 16 million truck drivers are involved in intercity freight transport, and drivers account for around 40 percent of total cost.[286] Other options including analytics-enabled demand forecasting, automation of sales and customer service, predictive maintenance, and autonomous port terminals, but these solutions are likely to generate relatively limited cost savings.

•••

Three digital forces have the power to shift and create significant value in China, with different patterns of impact depending on the stage of digitization and the particular characteristics of each sector. According to our simulation, the impact of digital disruption in China could be equivalent to 10 to 45 percent of the industry revenue pools by 2030 in the four sectors analyzed. As digitization takes hold in very different sectors, removing inefficiencies and creating innovative business solutions, China's economy will become more dynamic, and more Chinese businesses will be able to compete globally and even export "Made In China" digital business models. The next question is what this means for policy makers, a topic we turn to in our next chapter.

[285] *The Internet of Things: Mapping the value beyond the hype*, McKinsey Global Institute, June 2015; and *Digital Australia: Seizing the opportunity from the Fourth Industrial Revolution*, Digital McKinsey, May 2017.

[286] "China may overtake the U.S. as the No. 1 in realizing autonomous truck commercialization," TuSimple, January 3, 2017.

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4. IMPLICATIONS FOR POLICY MAKERS

China's government—at the national and local levels—has already done a significant amount to encourage the expansion of the digital ecosystem as a major consumer of digital technologies and as an investor in digital innovation, as we noted in Chapter 1. But in order to manage and accelerate China's transition toward being a digital economy, more can be done. In this chapter, we briefly explore the possible contributions of policy makers (Exhibit 38).

Exhibit 38

China's government can play multiple roles in digitization

Government role	Priority measures
Be an active investor in, and consumer of, digital technologies	▪ Continue to be an active investor in and consumer of technology. It can, for instance, create a market for frontier technologies such as 5G and AI ▪ Digitize government operations. China ranked 63rd of 193 countries on the UN 2016 e-government index ▪ Continue to invest in expanding the basic digital infrastructure to overcome digital divides. Internet penetration is 69 percent in urban China but 33 percent in rural areas. Through One Belt, One Road, and the government can help others close their digital divides
Promote healthy competition	▪ Monitor potential emergence of "digital monopolies." Regulate any abuse of power to secure unfair advantage ▪ Lower entry barriers to encourage new players to compete with large incumbents ▪ Promote open data to level playing field for new and smaller players
Manage labor markets during digital disruption	▪ Support lifelong learning and job redeployment, and reform education ▪ Support new ways of working in the gig economy ▪ Improve labor mobility to minimize friction during the transition
Contribute to global debates on digital governance	▪ Continue to seek opportunities for international collaboration to reach global consensus on key issues including cybersecurity, digital standards, intellectual property protection, digital sovereignty, and measurement of the digital economy

SOURCE: McKinsey Global Institute analysis

The government can continue to be an investor in and consumer of digital technologies to facilitate digitization and help to reinforce China's increasing global prominence in digital. Given the powerful winner-takes-all dynamics in digital that have propelled a small number of internet giants into strong market positions, regulators should ensure that there is sufficient healthy competition to serve consumers' interests. As value chains are restructured, there will undoubtedly be disruption to jobs, and the government needs to help workers to cope with the transition. Finally, the global transition toward a digital era raises major questions about topics including digital sovereignty and reciprocity. Given China's increasing influence on the world's digital landscape, it is important that the government continues to contribute to international debates in order to reach a global consensus.

Internet penetration gap in urban vs. rural areas was

36%

in 2016

CONTINUE TO BE AN IMPORTANT INVESTOR IN AND CONSUMER OF DIGITAL TECHNOLOGIES AND INFRASTRUCTURE

The Chinese government has, as we noted in Chapter 1, played an active role as an investor in and consumer of technology—an important contribution, especially when there is uncertainty about the long-term market potential of a particular digital solution. For instance, the government can create a market for frontier technologies such as 5G and AI, encouraging long-term investment and innovation by companies.

Digitizing its own operations would make a substantial contribution to consumption of digital technologies in China—and boost its productivity.[287] This is a priority that the Chinese government recognizes. China ranked 63rd out of 193 countries on the United Nations' 2016 e-government index. This was seven places higher than in 2014, but low compared with regional neighbors such as South Korea (third) and Singapore (fourth).[288] The McKinsey Center for Government suggests that governments focus on four key areas: digitizing interfaces with citizens; automating back-office processes to boost efficiency; integrating advanced data analytics; and digitizing their data and sharing them with the public (see the discussion of data sharing later in this chapter).[289]

At the same time, the government can continue to invest to expand the infrastructure needed to address the persistent divide between China's digital haves and have-nots. In 2016, internet penetration in wealthy provinces on China's east coast such as Guangdong and Fujian was 70 percent, but it was only around 40 percent in underdeveloped provinces such as Gansu, Guizhou, and Yunnan, according to the China Internet Network Information Center. Similarly, internet penetration stands at around 69 percent in urban areas, compared with only around 33 percent in rural areas. Indeed, the urban-rural gap has widened somewhat, from 34 percent in 2015 to 36 percent in 2016.[290] In addition to supporting further internet penetration, policy makers can support people's ability to benefit from the internet by moving beyond simple functions such as search and messaging to using more advanced applications such as e-commerce and finance.

In 2013, the State Council launched its Broadband China initiative, which aims to invest two trillion renminbi ($301 billion) by 2020 to achieve full broadband coverage and improve the speed of the broadband network. Since 2013, the effort has made substantial progress. At the end of 2016, penetration of fixed and mobile broadband was 61 percent and 71 percent, respectively, compared with only 13 percent and 17 percent in 2012. China's 13th Five-Year Plan set a target of 70 percent for fixed-line broadband and 85 percent for mobile broadband by 2020.

China's government can also contribute to closing the digital divide beyond its borders.[291] One vehicle for doing so is China's One Belt, One Road initiative, which seeks to replicate the old Silk Road trading routes between China and other continents. Digital technologies are already being incorporated into what Chinese authorities are calling an "information

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[287] Although measuring government productivity is not straightforward, evidence from around the world suggests that digitizing government operations and applying time- and cost-saving tools to the delivery of services are powerful ways to enhance efficiency. MGI research suggests that digitization and advanced analytics could deliver productivity improvements globally in government and public sectors of at least $1 trillion. See *Digital America: A tale of the haves and have-mores*, McKinsey Global Institute, December 2015; *Digital Europe: Pushing the frontier, capturing the benefits*, McKinsey Global Institute, June 2016; and *Government productivity: Unlocking the $3.5 trillion opportunity*, McKinsey Center for Government discussion paper, April 2017.

[288] *United Nations e-government survey 2016: E-government in support of sustainable development*, Department of Economic and Social Affairs, United Nations, 2016.

[289] See *Digital by default: A guide to transforming government*, McKinsey Center for Government, November 2016.

[290] *China statistical report on internet development*, China Internet Network Information Center, January 2017 (http://cnnic.cn/hlwfzyj/hlwxzbg/hlwtjbg/201701/P020170123364672657408.pdf).

[291] *China's role in the next phase of globalization*, McKinsey Global Institute discussion paper, April 2017.

Silk Road."[292] The world still has a large digital divide between people and businesses with access to these technologies, who are therefore economically empowered, and those who do not and are therefore shut out of economic opportunity.[293] At the end of 2016, four billion people, or 53 percent of the world's population, remained offline; only 11.9 percent had access to fixed broadband.[294] Also in 2015, the Pew Research Center found that a median of 54 percent in 21 emerging and developing countries reported using the internet at least occasionally or owning a smartphone, compared with 87 percent in 11 advanced economies.[295]

PROMOTE DYNAMIC AND HEALTHY COMPETITION TO FUEL INNOVATION AND SERVE THE INTERESTS OF CONSUMERS

Network effects, in which the value of products or services increases significantly with the number of users, are a proven feature of the digital economy and contribute to winner-takes-all dynamics. Around the world, digital monopolies or near monopolies have appeared, and China is no exception. It is important for regulators to ensure that there is healthy competition not only to encourage commercial success and innovation, but also to protect consumers. One way of creating a level playing field is to encourage open and shared data.

Ensure dynamic and healthy competition

~1/2
of top 50 Chinese startups associated with Baidu, Alibaba, and Tencent

Scale and market concentration can create advantages such as enabling winning companies to make the large investments that fuel innovation in cutting-edge technologies like AI and autonomous driving. Companies with dominant market positions have benefited consumers by offering convenient one-stop solutions and free services.

In China, Baidu commands a large majority of the market in search, and Alibaba has a large majority of e-commerce transactions. Tencent's WeChat and QQ now cover a substantial portion of China's population. The BAT companies' influence in China's digital economy is larger than that of FANG in the United States. For example, the BAT trio contributed 42 percent of local venture capital investment in China, compared with 5 percent by FANG in the United States. As we noted in Chapter 1, about half of the top 50 startups are associated with BAT companies.

But their market dominance also raises concern. Technology giants are accumulating and controlling massive amounts of data and could use their power to lock in consumers and stifle competition. To ensure that consumers continue to benefit from digital technologies, it is therefore important to ensure dynamic and healthy competition.

But it is difficult for regulators—in China and elsewhere—to judge the scope and optimal timing of competition regulation given the fact that the digital economy is so new and evolving so rapidly. Even defining when a company becomes a monopoly is not straightforward. Although many key players in the digital economy are very large and profitable firms, many of them still face vigorous competition, and competition in digital

[292] *Vision and actions on jointly building silk road economic belt and 21st-century maritime silk road*, National Development and Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce, March 2015. Also see Rachel Brown, *Beijing's Silk Road goes digital*, Council on Foreign Relations, June 6, 2017; and *"One belt and one road": Connecting China and the world*, McKinsey & Company, July 2016.

[293] Lack of internet access has huge economic ramifications. Take access to finance as an example. MGI research in 2016 found that two billion people and 200 million businesses in emerging economies lack access to savings and credit, and that digital technologies can help to close this gap. The research found that financial services delivered via mobile phones and the internet could provide access to finance for 1.6 billion people in emerging economies, more than half of them women. Overall, widespread use of digital finance could boost the annual GDP of all emerging economies by $3.7 trillion by 2025, a 6 percent increase vs. a business-as-usual scenario. See *Digital finance for all: Powering inclusive growth in emerging economies*, McKinsey Global Institute, September 2016.

[294] *The state of broadband 2016*, International Telecommunication Union and UNESCO, September 2016.

[295] Keith Breene, *This is the extent of the demographic digital divide*, World Economic Forum, March 22, 2016.

markets is dynamic or cyclical in nature, making it difficult to sustain leading positions.[296] Regulators in all countries need to watch carefully to see whether monopolies persist or break down naturally as new technologies emerge.

Debate about digital monopolies has emerged in China. A 2013 case related to a security software installation on a social-media platform and alleged violation of China's Anti-Monopoly Law was dismissed by the Supreme People's Court. In its decision, the court noted that, because many internet-based products are free to consumers, courts should look at decreases in quality rather than increases in price as a sign of monopoly power, and further that market share alone may be an unreliable indicator of market dominance in the internet sector because it is "highly dynamic and the boundaries of the relevant market are far less clear than those in traditional sectors."[297] Regulators are reviewing other cases (including a major ride-sharing merger) to see whether they should be subject to antimonopoly law.[298]

Policy makers may need to refine the regulatory framework by putting consumers at the center. For example, the current law, put in place in 2007, can rarely be applied to predatory pricing because the internet is free, and many new business models have not yielded sustainable profits despite aggressive pricing. In such cases, regulators can also explore unfair competition law (selling product below cost) and consumer protection law (consumers have the right to choose products or services independently).[299]

It is not easy to know if a monopoly will be sustained but, in any case, it is important that regulators consistently watch for market abuses by dominant companies. In China, regulators can investigate whether large digital platforms are suspected of abusing their power and securing unfair advantage. A search engine may, for instance, manipulate algorithms to promote its own interests and limit competition, or a social media company might collect consumer data without consent and abuse those data for commercial purposes, violating consumers' privacy.

Regulators can also ensure that entry barriers are low so that new players can compete with incumbents. It may be that market concentration is not the key issue, but rather, high entry costs for new players or large switching costs for consumers.[300] The World Bank notes that scope for anticompetitive behavior varies among digital products and services. In the case of search engines, for instance, the network effects and switching costs tend to be large, which creates barriers to scale for new firms offering search. But in the case of ride sharing, which can easily be imitated, entry barriers are low, and competition has reduced prices for consumers.[301]

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296 *The digital economy*, Directorate for Financial and Enterprise Affairs, Competition Committee, OECD, February 7, 2013.

297 For more detail on this case, see John M. Walker, *China cases Insight No. 1: In Qihu v. Tencent, the Chinese Supreme People's Court offers antitrust insight for the digital age*, Stanford Law School China Guiding Cases Project, May 5, 2015.

298 April Ma, "One year on, Didi-Uber union still under antitrust scrutiny," Caixin, July 28, 2017.

299 *Could "big data" facilitate monopoly and how shall we step in?* King & Wood Mallesons, June 15, 2017.

300 Jean-Charles Rochet and Jean Tirole, "Platform competition in two-sided markets," *Journal of the European Economic Association*, volume 1, issue 4, June 2003.

301 *Digital dividends*, World Development Report 2016, World Bank, 2016.

China ranks
71ST
of 144 countries
on open data

Promote open data to level the playing field

Another important way that the government can promote a competitive environment is by encouraging the sharing of data—including its own. Today, data in China—as elsewhere—remains siloed. Governments own a great deal of data, and many countries are embracing open data gathered digitally across government.[302] According to the Open Data Barometer published by the World Wide Web Foundation based on the assessment of 15 data sets, China ranks 71st out of 114 countries.[303]

In 2015, the State Council announced a plan to promote big and open data and launched the Internet Plus initiative. It said that the government would formulate regulations to guarantee open social access to public data. An open platform is expected to be established by the end of 2018 that contains data in priority areas such as credit, transportation, medical care, health, and employment. Internet Plus supports promoting improved information sharing among government departments, enabling members of the public and businesses to make fewer physical visits to government offices and to benefit from simpler procedures and higher service quality.[304] Progress has been made. Some provincial governments in China now accept passport and visa applications and provide updates on weather and traffic through WeChat. Beijing's open data website even has a section where apps developed by individuals based on open data can be submitted and then used by the public.[305] In August 2017, a body described as the world's first internet court opened in Hangzhou to focus on internet-related disputes—and the entire process happens online.[306]

MANAGING LABOR MARKETS DURING A TIME OF DIGITAL DISRUPTION

Digitization will inevitably have an effect on the labor market. In order to understand this impact, three dimensions can be considered: the creation of jobs due to changes in macro-driven demand, the destruction of jobs due to productivity gains (arising out of automation, for instance), and the destruction of jobs due to digital forces reshaping value chains.[307]

Our simulation indicated that these effects could leave net demand for jobs at between 745 million and 788 million by 2030 in a base case. Due to the shrinking working-age population, the labor supply could decline from today's 773 million to 757 million by 2030. This means that if China manages the transition well, the shock on the labor market can be managed (Exhibit 39). In fact, given the shrinking labor force and rising wages, digital disruption and productivity improvements can help China to stay competitive in the global market.

To manage the transition in a way that helps people navigate through a period of disruptive change, the government can equip them with the skills they need through reform in education and training; use digital technology to help people find jobs and help employers fill them; support people working independently in the gig economy; and do everything in its power to enhance labor mobility to ease job searches than may end in a different city.

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302 For further discussion, see *Open data: Unlocking innovation and performance with liquid information*, McKinsey Global Institute, McKinsey Center for Government, and McKinsey Business Technology Office, October 2013.

303 Open Data Barometer (http://opendatabarometer.org/?_year=2016&indicator=ODB).

304 *China's focus on Internet Plus governance*, The State Council of the People's Republic of China, February 1, 2017.

305 The big data platform of the Beijing government (http://www.bjdata.gov.cn/index.htm).

306 The litigation platform of the Hangzhou Internet Court (http://www.netcourt.gov.cn/portal/main/domain/index.htm).

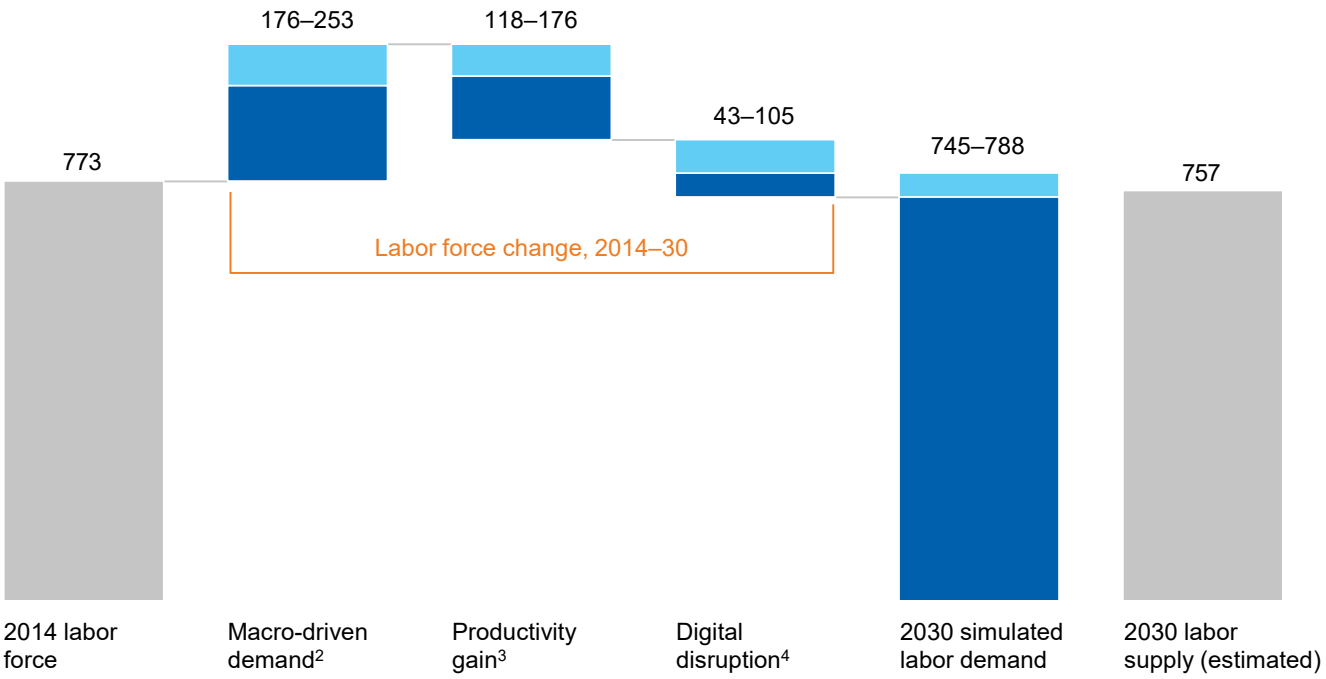
307 For further discussion, see *Jobs lost, jobs gained: Workplace transitions in a time of automation*, McKinsey Global Institute, November 2017.

Exhibit 39

The impact on the labor market can be managed if an effective transition program is in place

SIMULATION[1]

Digital impact on full-time equivalent positions in the labor force created and displaced
Million



1 The simulation does not estimate total job turnover in the economy.
2 Trendline demand scenario for new jobs driven by macro factors including rising income, aging, infrastructure, technology, and others.
3 Driven by adoption of automation levers (50–75% adoption of technological potential).
4 Disruption based on three forces: disintermediation, disaggregation, and dematerialization.

SOURCE: National Bureau of Statistics of China; McKinsey Global Institute analysis

Support lifelong learning and job redeployment, and reform education

Although MGI finds that less than 5 percent of occupations can be automated entirely, two-thirds of jobs worldwide have components that can be automated by adapting existing technology.[308] Increasingly, people will need to work alongside robots and employ AI. Many jobs will be "machine enhanced." But this will require a transformation in the way that education and training develops people's skills. The World Economic Forum estimates that by 2020, on average more than one-third of core skills in most occupations will be different from those considered necessary today.[309]

The Chinese government has begun to take action to update the population's skills for the digital age. One thrust of policy is training for workers who lose their jobs in one occupation and need to redeploy elsewhere in the economy. In the 13th Five-Year Plan, the Ministry of Human Resources and Social Security declared its intention to provide vocational training for the digital economy to 40 million workers. In the wealthy province of Jiangsu, the government plans to expand professional training so that it serves up to 20 million people through a network made up of 500 digital platforms by 2020.[310] Similarly, in Guangdong Province, the government's plans include setting curriculum standards for 50 professional

[308] *A future that works: Automation, employment, and productivity*, McKinsey Global Institute, January 2017.
[309] *The future of jobs: Employment, skills and workforce strategy for the Fourth Industrial Revolution*, World Economic Forum Global Challenge Insight Report, January 2016.
[310] *The plan of training program for professional skills*, General Office of Jiangsu Provincial Government, March 2017.

courses and publishing more than 1,000 textbooks by 2020, an effort aimed at helping people who lose their jobs to automation to develop new skills. The province of Jilin has promised to build 50 model schools and guarantees that all counties will have their own vocational education center during the 2016 to 2020 period covered by the 13th Five-Year Plan.

The government can work with the private sector to ensure that vocational training develops the most relevant skills. Some examples of this collaboration are emerging. In 2016, China's Ministry of Industry and Information Technology worked with Alibaba on a Rural Taobao Program that encouraged migrant workers to start their own businesses on Alibaba's e-commerce platform by offering financial support and training.[311]

>23K
innovation-related courses set up in China by end 2016

The rise of the knowledge economy and the need to continually reskill citizens to keep pace with technological change has reinforced the imperative of lifelong learning. In the EU, for instance, the European Commission has an Education and Training 2020 goal of requiring at least 15 percent of adults to participate in lifelong learning through education and training programs provided by member states.[312] Similar programs are in place in China. For example, since 2012, the government of Shanghai has been developing an academic credit bank, an institution that recognizes accreditation, credits earned in adult higher education courses, and more than 200 vocational certificates.[313] Academic credit banks opened in the provinces of Jiangsu and Zhejiang in 2016. Each person has a "credit account," which records lifelong training outcomes. In addition, the Ministry of Education holds a national lifelong learning week every year.

Educational reform can be a structural solution. The 13th Five-Year Plan aims to encourage student entrepreneurship, innovation capabilities, and practical skills, and to focus on Internet Plus educational training to boost the development and sharing of digital education solutions.[314] By the end of 2016, China had set up over 23,000 courses related to innovation and entrepreneurship and trained 26,000 teachers focusing on the subjects.[315] Curricula will need to be rethought. For instance, skills such as memorizing facts, which have been a cornerstone of Chinese education, are becoming obsolete; other skills such as problem solving and communication must become more prominent.

Investment in education, skills, and retraining for dislocated workers is just the start—ensuring that the training is effective is paramount. Around the world, the record of training programs has been mixed. A McKinsey analysis of more than 100 education-to-employment initiatives in 25 countries found that these programs fail more often than they succeed.[316] MGI has found that globally very few midcareer training programs operate at scale.[317] All training, skilling, and retraining programs must be tracked and monitored and outcomes measured to ensure that they offer value for money and actually lead to employment. McKinsey founded a youth employment nonprofit called Generation that, within two years of its launch, had become the largest demand-driven skilling program in

311 "National Development and Reform Commission investigates rural Taobao," CPC News, July 7, 2016 (http://cpc.people.com.cn/n1/2016/0708/c64387-28537743.html).

312 *Education and training 2020*, European Commission, May 2009. Also see http://ec.europa.eu/education/lifelong-learning-programme_en.

313 Han Min, *The new progress on lifelong learning education policies in China*, National Center for Education Research Development, ASEM Lifelong Learning Research Hub Network 4 meeting, East China Normal University, December 12, 2011.

314 *China to improve education during 13th Five-Year Plan period*, The State Council of the People's Republic of China, January 19, 2017.

315 *An inexorable trend in Chinese education reform of innovation and entrepreneurship*, Ministry of Education, September 9, 2017 (http://www.moe.gov.cn/jyb_xwfb/xw_fbh/moe_2069/xwfbh_2017n/xwfb_2017090801/mtbd_2017090801/201709/t20170911_314104.html).

316 *Education to employment: Designing a system that works*, McKinsey Center for Government, January 2013.

317 *Jobs lost, jobs gained: Workplace transitions in a time of automation*, McKinsey Global Institute, November 2017.

the world. An important part of this venture is measuring results, and the program is moving toward a new integrated measure called "cost per employed," or CPED, that essentially measures how many employment days are generated for every dollar invested.[318]

Support new ways of working in the gig economy

Technological change disrupts jobs in more than just a negative sense; it can enable new, more flexible ways of working. The digital economy offers new opportunities for entrepreneurship and self-employment, for instance. MGI surveyed around 8,000 respondents in Europe and the United States and found that up to 162 million people, or 20 to 30 percent of the working-age population in these regions, engaged in some form of independent work—the so-called gig economy.[319]

China's gig economy is expanding rapidly. Demand for part-time jobs almost doubled in 2016 from a year earlier, outpacing 25 percent growth for new full-time jobs, Zhaopin data show.[320] An increasing number of these independent workers use digital platforms to find work. Ziwork, a Chinese platform for freelancers, has 60,000 registered professionals. The number of Chinese users of LinkedIn now stands at 32 million three years after the platform entered the Chinese market. Users can connect their LinkedIn accounts to WeChat and Alibaba's Ant Financial.[321]

The rise of the gig economy and on-demand talent has implications for regulators. Many labor-market policies such as retirement plans and compensation for on-the-job injuries are not portable and may not apply to those working independently. Should independent workers be classified as regular employees or as contractors, and how does this affect the way they are taxed? In many countries, freelancers have very limited social benefits, such as insurance and pensions.

Chinese regulators are gradually responding to these issues. For example, China has established a preliminary system of insurance for independent workers, and the 13th Five-Year Plan promises to extend coverage by 50 percent. Individuals can voluntarily register for the insurance; payments are based on the average salary in the applicant's province. However, only 17 percent of individual businesses pay endowment insurance for their staff. The penetration rates of medical insurance, employment injury insurance, and unemployment insurance are only 18 percent, 10 percent, and 6.4 percent, respectively. Moreover, only 4 percent of businesses enjoy the benefits of the housing accumulation fund system.[322] As the digital economy continues to develop in China, policy makers can gradually improve the situation.

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[318] McKinsey estimates that employment days produced by Generation graduates are up to 3.5 times those that arise from conventional skilling programs. See Rajat Gupta and Saipriya Sarangan, "Redefining the economies of skilling," *Business Standard*, July 27, 2017. Also see the Generation website (https://www.generation.org/#).

[319] *Independent work: Choice, necessity, and the gig economy*, McKinsey Global Institute, October 2016.

[320] Meng Jing, "Pots of gold await in China's gig economy: How mobile technology is transforming the world's biggest jobs market," *South China Morning Post*, February 26, 2017.

[321] "LinkedIn China users top 32 million," *China Daily*, April 27, 2017.

[322] See *Current situation and future trends of employment in the individual business economy*, CEINET, February 3, 2016 (http://www.saic.gov.cn/xw/mtjj/201602/t20160203_188477.html); and "Social insurance has covered the whole of society," Ministry of Human Resources and Social Security, December 14, 2016 (http://www.mohrss.gov.cn/SYrlzyhshbzb/dongtaixinwen/buneiyaowen/201612/t20161214_261978.html).

Improve labor mobility and minimize friction during the transition

Labor mobility facilitates the diffusion of knowledge among firms and across geographies.[323] In an era of digital disruption and automation, it is important to support workers transitioning from one place to another in search of work.

In particular, China can continue to reform its labor mobility program. Labor mobility in China has long been constrained by the Hukou registration system, which has been in place for 60 years.[324] Under the system, Chinese citizens who move from rural areas to urban areas do not have access to many of the benefits—including education for their children—that people registered and already living in cities enjoy. This deters relocation and reinforces economic and social inequality. In 2014, the State Council published reform guidance in an attempt to eliminate the differences between rural and urban Hukou. In the future, both will be called residential Hukou. In 2015, the government announced a plan to abolish temporary residence permits, which have attracted controversy. It is moving toward reform of the household registration system, with permanent residence permits that give holders many of the same privileges as local residents, such as social security, the right to buy apartments and cars (only locals or migrants who have paid local taxes for five years have this right today), and access to public services.[325]

More can be done. One area is compensation for migrant workers when they have to give up land rights in rural areas in order to apply for urban Hukou. Another area is portability of welfare contributions across regions, which can help migrant workers. More fundamentally, the capacity to deliver services in cities needs to expand to enable people to migrate to urban areas. The Chinese Academy of Social Sciences calculates that providing schooling, health care, and other benefits costs 100,000 renminbi ($15,100) for every rural migrant who is eligible—in other words, 100 billion renminbi ($15.1 billion) for every one million eligible migrants.[326]

CONTRIBUTE TO GLOBAL DEBATES ON DIGITAL GOVERNANCE AND WORK TOWARD GLOBAL CONSENSUS

As digital technologies transform the global economy and the way people live, there are huge debates about how to react and how to govern the digital world. Countries can collaborate on some global issues, including cybersecurity, intellectual property rights, and global digital standards and measurements. We do not take a view on the rights or wrongs of individual nations' IT trade policy or intellectual property laws. Rather, we suggest that it benefits all governments to work together to reach a consensus on issues such as technological standards. Not collaborating risks losing the opportunity to benefit from global digital innovation. China is already part of many discussions on relevant issues.

[323] See *The contribution of labour mobility to economic growth*, International Labour Organisation, OECD, World Bank Group, joint paper for G20 Labour and Employment Ministers' meeting, Ankara, Turkey, 3-4 September 2015; and Per Thulin, *Labor mobility, knowledge diffusion and regional growth*, CESIS Electronic working paper series, number 209, December 2009.

[324] Hukou is the household registration system in China, which assigns people to urban and rural locations (cities or provinces) for allocation of social benefits, which are administered at the local level. A citizen without a local hukou registration may not be able to obtain education, health care, or pension benefits.

[325] *China to abolish controversial temporary residence permit*, xinhua, February 15, 2015.

[326] "Reform's big taboo: An ambitious plan for social change has run into trouble," *Economist*, March 26, 2016.

- **Cybersecurity.** Cyber threats are growing more serious by the day. This is a global challenge that can only be tackled through international collaboration. In 2016, more than 4.2 billion records were lost in more than 4,000 incidents, an all-time high.[327] Joint research by the World Economic Forum and McKinsey estimated that between $9 trillion and $21 trillion of global economic value creation depends on the robustness of cybersecurity in the period to 2020.[328] Some observers note that there is a high risk of breaches of consumer data in China because of lax controls within corporations. For instance, the China Banking Regulatory Commission recently criticized several banks for allowing their employees to sell personal information without any corporate oversight.[329] Many countries are collaborating to tighten up cybersecurity. In 2015, China and the United States agreed to "provide timely responses to requests for information and assistance concerning malicious cyber activities" and "refrain from conducting or knowingly supporting cyber-enabled theft of intellectual property."[330] Continuing to broaden global collaboration and co-develop concrete measures will be beneficial to all stakeholders.

- **Digital standards.** China can contribute to the development of international standards for digital infrastructure and technology that can enable global innovation and collaboration, and can minimize wasted investment on overlapping or similar technologies. Interoperability and the development of international standards are the keys to unlocking the true and full value of technologies such as IoT and AI. MGI research has found that 40 percent of the potential value associated with IoT requires interoperability among IoT systems.[331] Given the extraordinary amount of data being generated in China, it is in a unique position to be a leading player in this effort. There are already examples of useful standard setting. In the United States, for instance, in 2009 the Securities and Exchange Commission made it mandatory for all public companies to issue financial statements in extensible business reporting language to ensure that they are machine readable.[332]

Nearly
110K
civil intellectual property cases in China's courts in 2015

- **Intellectual property protection.** In the past, China's lack of protection for intellectual property was regarded as a major deterrent to long-term innovation in the economy. But China has made considerable progress in putting in place protections for intellectual property. It set up dedicated intellectual property courts in Beijing, Guangzhou, and Shanghai in 2014 that adjudicate cases concerning patents, new plant species, integrated circuit layout designs, and protected technology and computer programs.[333] In December 2015, the State Council unveiled a strategy to strengthen protection of intellectual property further.[334] In 2017, an additional four intellectual property rights tribunals were set up.[335] China now has trademark, patent, and unfair competition laws, and it has established a State Intellectual Property Office, a National Copyright Administration, and the State Administration of Industry and Commerce. In 2015, these various courts accepted nearly 110,000 civil intellectual property cases, up 6 percent from the previous year; of these, more than 11,000 concerned patents. To put this into perspective, the number of cases filed in the United States is only about 13 percent of

[327] *2016 data breach trends: Year in review*, Risk Based Security, January 2017.
[328] Tucker Bailey, Andrea Del Miglio, and Wolf Richter, "The rising strategic risks of cyberattacks," *McKinsey Quarterly*, May 2014. Also see *Hit or myth? Understanding the true costs and impact of cybersecurity programs*, McKinsey & Company, July 2017.
[329] Gordon Orr, *What can we expect in China in 2017?* McKinsey & Company commentary, January 2017.
[330] John W. Rollins et al., *U.S.-China Cyber Agreement*, CRS Insight, October 16, 2015
[331] *The Internet of Things: Mapping the value beyond the hype*, McKinsey Global Institute, June 2015.
[332] *Artificial intelligence: Implications for China*, McKinsey Global Institute discussion paper, April 2017.
[333] For a comprehensive summary of action in China on intellectual property, see *China's innovation ecosystem*, World Economic Forum white paper, August 2016.
[334] *Several opinions on the establishment of an intellectual property strong country in the new situation*, State Council, number 71, 2015.
[335] *China's innovation ecosystem*, World Economic Forum white paper, August 2016.

the total filed in China. In China, 65 foreign plaintiffs won all of their cases against other foreign companies in cases conducted in Beijing's intellectual property court in 2015.[336] Even foreign plaintiffs suing Chinese companies won about 81 percent of their patent cases, about the same share as domestic Chinese plaintiffs.[337]

Areas that could further enhance the protection of intellectual property in China would be worth exploring. One could be discovery—the sharing of information by both sides in a case. Another could be allowing the granting of punitive damages, especially in cases where infringement of intellectual property is proved to be malicious and compensation is deemed insufficient. In November 2016, the Chinese authorities appeared to reach consensus that punitive damages for willful infringement should be codified into patent law and copyright law.[338] Finally, cross-border pacts on intellectual property can be pursued to encourage higher levels of trust among investors. China instituted agreements on theft of intellectual property and trade secrets with the United Kingdom and Australia in 2015 and 2017, respectively.[339]

- **Digital sovereignty.** Like other governments, the government of China is eager to assert jurisdiction over internet activity within its own borders—to maintain its "digital sovereignty." In March 2017, the government issued a statement asserting sovereignty as a basic principle, saying that "every country has the right and responsibility to maintain its cybersecurity and protect the legitimate rights and interests of various parties in cyberspace through national laws and policies."[340] In line with this broad approach, China intends to maintain control over a wide range of data, including public telecommunication, information services, energy, transportation, and finance—an approach generally called data localization—and that a security assessment must be carried out before any data are transferred out of China.[341] In June 2017, a new cybersecurity law came into force that requires data related to Chinese citizens or national security to be held on Chinese servers, and requires companies to undergo regulatory review before transferring large amounts of data out of the country.[342]

  Although new regulations may reflect legitimate concerns about privacy and security, there might be costs. One study of six developing countries and the EU-28 concluded that regulations can reduce GDP by up to 1.7 percent, investment by up to 4.2 percent, and exports by 1.7 percent.[343] Another study found that in many countries that have, or are considering, data-localization laws, local companies would pay 30 to 60 percent more for their computing needs than if they were to operate outside that country's borders.[344] Almost half the respondents to a European Chamber business survey in 2017 said tighter control of the internet had had a larger impact on their business that year

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336 *The Beijing IP court gave foreign IP plaintiffs a perfect 65-0 win rate in 2015, reports one of its judges*, IAM, July 4, 2016.

337 Jack Nicas and Josh Chin, "Stronger Chinese patent laws also help U.S. companies," *Wall Street Journal*, July 20, 2016; and Wayne Sobon, *The surprising rise of China as IP powerhouse*, TechCrunch, April 11, 2017.

338 *China's new promises and measures to enhance IP protection*, LexField Law Offices, December 7, 2016; and *Complete the intellectual property protection system*, State Council, November 27, 2016 (http://www.gov.cn/zhengce/2016-11/27/content_5138533.htm).

339 See *UK-China joint statement on building a global comprehensive strategic partnership for the 21st century*, Foreign & Commonwealth Office, October 22, 2015; and *Australia and China agree to cooperate on cybersecurity*, statement by the prime minister and minister for foreign affairs of Australia, April 24, 2017.

340 *National cyberspace security strategy*, Cyber Administration of China, December 27, 2016 (http://news.xinhuanet.com/politics/2016-12/27/c_1120196479.htm).

341 *Law of the People's Republic of China on cyber security*, National People's Congress of the People's Republic of China, November 7, 2016 (http://www.npc.gov.cn/npc/xinwen/2016-11/07/content_2001605.htm). Also see *Digital dividends*, World Development Report 2016, World Bank, 2016.

342 Yuani Yang, "China's cyber security law rattles multinationals," *Financial Times*, May 30, 2017.

343 Matthias Bauer et al., *The costs of data localization: Friendly fire on economic recovery*, ECIPE Occasional Paper 3/2014, European Centre for International Political Economy, Brussels, 2014. For a general discussion, also see *Digital dividends*, World Development Report 2016, World Bank, 2016.

344 *Quantifying the cost of forced localization*, Leviathan Security Group, 2015.

than previously, and more than one-fifth said that restrictions had cost them 10 percent or more of their annual revenue in China. [345]

Western business organizations that took issue with China's new cybersecurity law charged that it was a form of protectionism and was not in the spirit of reciprocity, a principle enshrined in World Trade Organization rules.[346] In essence, reciprocity in global trade means lowering of import duties and other barriers to trade in return for similar concessions from another country. The issue of reciprocity between China and advanced economies such as the EU and the United States has been much debated, and it can apply today as much to digital trade as to trade in physical goods and services.[347] The temperature is rising in that debate, with ever more vocal complaints coming from Western companies and politicians. Take the case of cloud computing, where Chinese regulation requires local partnership and restricts foreign holdings of equity. In late March 2017, more than 50 US politicians sent a letter to the Chinese ambassador to the United States complaining that China's regulations on cloud computing would prevent foreign cloud service providers from operating and competing fairly in the country.[348]

- **Measuring the digital economy.** It is far from clear that the full economic impact of the digital economy is being captured in traditional measures of GDP and productivity. This is a topic of global concern. The inability to quantify the benefits of digitization—the mismeasurement hypothesis—could partly explain the so-called productivity paradox, which states that despite widespread efficiency gains, productivity growth seems to be declining rather than picking up.[349] In addition, the sharing economy can reduce consumption in some sectors. This may lower GDP, but the counterbalancing efficiency gains are not captured. A great deal of debate surrounds the mismeasurement hypothesis. Nevertheless, policy makers are sufficiently convinced that there is a measurement issue that they have started considering different ways of calculating GDP and looking at other indexes that better reflect consumer surplus. For instance, South Korea plans to add the digital sharing economy to its GDP measure beginning in March 2019.[350] China, which for a long time has focused on GDP as the key measure of economic performance, is also attempting to incorporate "new economies," including the sharing economy, in its measurement of GDP.[351] More discussion and knowledge sharing among countries will help in the search for improved measurement of the digital economy.

[345] Yuan Yang, "Multinationals in China brace for online crackdown," *Financial Times*, July 31, 2017.

[346] See, for instance, Kyle Bagwell and Robert W. Staiger, *Reciprocity, non-discrimination and preferential agreements in the multilateral trading system*, National Bureau of Economic Research working paper number 5932, February 1997; and Marion Panizzon, Nicole Pohl, and Pierre Sauv, eds., *GATS and the regulation of international trade in services*, Cambridge University Press, July 2008.

[347] See, for instance, Liu Jun, "Sino-US trade and investment relationship needs fairness and reciprocity," *South China Morning Post*, July 28, 2017; and Wendy Wu, "EU to seek reciprocity from China at top-level talks this week," *South China Morning Post*, May 31, 2017.

[348] Sui-Lee Wee, "As zeal for China dims, global companies complain more boldly," *New York Times*, April 19, 2017.

[349] For more on this issue, see, for instance, *The productivity puzzle: A closer look at the United States*, McKinsey Global Institute discussion paper, March 2017; Martin Neil Baily and Nicholas Montalbano, *Why is productivity growth so slow? Possible explanations and policy responses*, Brookings Institution, September 2016; David M. Byrne, John G. Fernald, and Marshall B. Reinsdorf, *Does the United States have a productivity slowdown or a measurement problem?* Federal Reserve Bank of San Francisco, working paper 2016-03, April 2016; Jan Hatzius et al., "Productivity paradox v2.0 revisited," *US Economics Analyst*, Goldman Sachs, September 2016; and Chad Syverson, *Challenges to mismeasurement explanations for the U.S. productivity slowdown*, NBER working paper number 21974, February 2016.

[350] "Korea's GDP to include digital sharing economy from 2019: BOK," *The Korea Herald*, May 29, 2017.

[351] "New economy gives rise to the underestimation of GDP," Xinhua News, July 2, 2016 (http://news.xinhuanet.com/fortune/2016-07/03/c_129111199.htm).

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The Chinese government's role in the economy's digitization has been an interesting mix of laissez faire and control. There is little doubt that the space it gave to emerging internet giants was a key factor in their growth and innovation. At the same time, the government has, through policy, lent considerable force to the process of digitization, and official plans, programs, and policy statements suggest that the government intends to continue to play a proactive part in China's digital revolution. The next question, which we briefly address in our final chapter, concerns the contribution companies in China can make and how they should respond to a fast-changing market environment.

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5. IMPLICATIONS FOR BUSINESS

Digital forces will shake the status quo, inevitably creating winners and losers, and responding to this sweeping disruption by adopting digital technologies needs to be a core strategy for companies around the world. Incumbents in many sectors are already feeling the heat of competition from digitally enabled startups and entrepreneurial companies with lean organizations that are unencumbered by legacy systems.

Given the scale of China and the rapid pace of its transformation into a digital economy, there is an even larger opportunity to benefit from digitization by acting boldly than in other geographies—and an even greater risk for those that do not move decisively to ride the digital wave. In addition to China's scale and the pace of change, the fact that many sectors of the economy exhibit inefficiencies and low productivity creates significant opportunities for disruption, which could potentially offer proactive companies considerable rewards. The scope for huge value shifts and creation is very substantial, at up to 45 percent of the revenue pools of four key sectors. Yet many incumbents have been slow to react; in China, a large share of executives profess themselves unprepared for Industry 4.0. It is vital that they move boldly to embrace digital and reap its significant benefits.

To win, companies in China can potentially pursue six approaches: adopt bold strategies; use the power of the digital ecosystem; maximize the value available from analyzing China's huge pools of data; build agile organizations for digital transformation; digitize operations based on a solid transformation program; and engage with national policies and regulation. These six approaches come from observable best practices in more digitized economies, but we believe that they are even more relevant in China (Exhibit 40).

Exhibit 40

Digital strategy matters (more) in China

Strategic implication	Why it matters (more) in China
Adopt bold strategies	▪ Huge room to shake the status quo through digital solutions. Productivity across sectors is only 15 to 30 percent of the OECD average. Inefficiencies such as industry fragmentation and information asymmetry along value chain create opportunities for digital attackers.
Use the power of the digital ecosystem	▪ Digital platforms play a more influential role in China. BAT companies have 500 million to 900 million monthly users in their respective business areas, offer cross-sector services through superapps, and support startups by contributing capital and talent.
Maximize value from data and analytics	▪ Massive amount of data generated every day. China has 731 million internet users, five billion online search queries on Baidu, average 66-minute daily usage on WeChat, and 175 million transactions a day on Alipay. ▪ More opportunities to monetize data. Survey shows that 64 percent of Chinese respondents are willing to pay subscriptions to connected-car services vs. 26 percent of US respondents and 8 percent of German respondents.
Build agile organizations	▪ Chinese firms tend to have hierarchical cultures. McKinsey's Organizational Health Index found Chinese firms score low on employee motivation with a tendency to "throw money at a problem."
Digitize operations	▪ Traditional businesses have huge potential to digitize. Survey shows that only 44 percent of Chinese SOEs say they are prepared for Industry 4.0 vs. 71 percent in the United States and 68 percent in Germany.
Engage with China's policy and regulation	▪ The government has made it clear that digitization of the economy is a major priority. 290 cities have initiated smart-city pilot projects, for example.

SOURCE: Company announcements; OECD; McKinsey Global Institute analysis

ADOPT BOLD STRATEGIES

Given current inefficiencies, China has huge potential to shake up the status quo through digital solutions. As we have noted, productivity across China's sectors stands at only 15 to 30 percent of the OECD average. Fragmentation and information asymmetries throughout the value chain—as we described in the case of China's freight and logistics sector, for instance—open the door wide open to digital attackers. To survive and thrive in what will be an increasingly competitive environment will require companies to be aggressive. The winner-takes-all dynamics that we have seen in the rest of the world are already evident in China, and we have observed in more digitized economies the very substantial impact on the bottom line of companies.

Previous MGI research found that bold, large-scale responses pay off three times as much as less aggressive reactions to digital disruption, and that unless companies fully align digital strategy with corporate strategy, they will not do better than break even on digital disruption. Even in the face of such evidence, however, the response of most companies has been inadequate. In a McKinsey survey, 90 percent of companies said that they had digitized in some form, but only 16 percent said they had done so boldly and at scale. Two-thirds of executives surveyed said that their companies had not made any fundamental changes to corporate strategy, only one in five companies had significantly adjusted their business

portfolios, and only one-quarter had fully aligned their digital and corporate strategies.[352] So the question is what an effective digital strategy might look like. Here we suggest some key components.

Assess vulnerability to digital disruption and determine strategic stance

As we discussed in Chapter 3, there is enormous scope for three digital forces to restructure value chains, shifting or creating value equivalent to as much as 45 percent of the revenue pools in the four sectors we examined in detail. A first step is for companies to assess how vulnerable they are to these digital forces.

- **Vulnerability to disintermediation.** Is the company operating in a sector that has high channel margins that may attract digital attackers to enter the market and shorten the value chain? Is there significant information asymmetry involving multiple layers of distributors? Are both supply and demand in the industry highly fragmented, and can multisided digital platforms emerge that can match them and offer more efficient transactions?

- **Vulnerability to disaggregation.** Does the company's industry have characteristics that make it suitable for disaggregation—high value, high durability, but fluctuating or underutilized? Is it technically feasible to turn underutilized assets into services by disaggregating them into smaller service offerings? Can multisided platforms emerge that enable the rapid expansion of supply, as they did in the case of workspaces and hotels, and cater to underserved demand, as in the case of shared mobility?

- **Vulnerability to dematerialization.** How technically feasible is it to convert physical products, services, or processes into digital formats in a company's sector? Is there an opportunity for the company to improve its value proposition for customers—cutting costs, speeding delivery, and/or boosting quality through dematerialization?

In addition to assessing their own potential vulnerability to these digital forces, companies need to take a view on whether and to what degree the forces may affect their sector. The answer to these questions depends on a combination of factors, including whether consumers will embrace new digitally driven solutions (an AI-enabled doctor, for instance), whether technology will advance rapidly enough to enable new solutions to make commercial sense (3-D printing on a mass rather than a niche scale), and what the stance of regulators is likely to be. By having a view on these—admittedly difficult-to-forecast—trends, companies can judge how digital disruption may evolve in their industry. The possibilities include rapid takeoff in an S-shaped curve, a gradual long-term shift, and technology never reaching scale and remaining an overhyped fad. Armed with a view of their own propensity to be disrupted and the likely evolution of disruption in their sector, companies can then decide how to respond. Again, they have choices. A company may decide to play offense from the beginning, leading digital disruption in its industry and hoping to secure first-mover advantage, or observe how disruption develops and act quickly when large threats or opportunities appear—a fast-follower strategy.

[352] In a McKinsey survey of C-suite executives around the world that captured responses from 2,000 traditional firms in more than 60 countries, 90 percent of companies said that they were engaged in some form of digitization, but only 16 percent of them had responded boldly and at scale. See Jacques Bughin and Nicolas van Zeebroeck, "The best response to digital disruption," *MIT Sloan Management Review*, summer 2017, April 6, 2017.

Disrupt business models

One way of being bold in the face of digital disruption is for a company to be willing to disrupt its own business model in order to compete with attackers. In retail, for instance, companies are turning offline legacy businesses into differentiation points. Best Buy built a loyal customer base through price guarantees and uses its offline stores to offer a combination of a superior shopping experience and the capacity to fulfill online orders: about half of e-commerce orders are either shipped or fulfilled through the company's physical stores.[353] In China, Suning, a leading electronics retailer, suffered a 60 percent drop in its share price in the late 2000s as e-commerce attackers rapidly gained share. The company has since responded by launching its own e-commerce platform, forming a strategic alliance with Alibaba by selling a 20 percent stake to its partner, and opening physical "cloud stores" that have space for customers to experience products in person and order them on their phones.[354] Suning had revenue of 149 billion renminbi ($22 billion) in 2016, and online accounted for 52 percent of that total. In order to combat the increasing threat from digital media, Hunan Television launched its own online channel, MGTV.com, and started offering online-only original series and variety shows. One of the original shows, *Super Mom*, generated 50 million views of its first two episodes, ranking first in mainland variety shows at that time.[355] In the automotive industry, we are already seeing digitization causing a shift from an ownership to a service model, and OEMs and their suppliers are having to adjust their approach accordingly. There are new opportunities to generate revenue and profits by investing in shared-mobility solutions, becoming a fleet operator, and using shared-mobility players as indirect sales channels.[356] Leading automotive manufacturers are competing with digital attackers by expanding their business models—think Daimler Car2Go, BMW's DriveNow, VW's MOIA, and GM's Maven.

Focus on developing new customers

Increasingly it will no longer be sufficient for incumbents to defend their existing customer base through cost cutting, automation, or service improvements.[357] If they are to compete with digital attackers, which often blur boundaries between sectors, incumbents must broaden their pool of customers and potential customers by offering integrated solutions. There are many examples of companies embracing this expansive approach. For instance, Rakuten Ichiba, Japan's single largest online retail marketplace, issues credit cards to tens of millions of members, offers financial products and services from mortgages to securities brokerage, runs one of Japan's largest online travel portals, and offers customers an instant-messaging app. As we noted in Chapter 1, the BAT companies now offer superapps to attract an ever-expanding base of loyal customers. As growth in the offline retail and office property sectors slows, leading Chinese real estate developers such as Vanke and Soho are exploring how to serve new customers in the digital economy, including freelancers, startups, and small companies. They are collaborating with "co-working" operators to bring in different types of tenants and business models.[358]

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[353] Khadeeja Safdar, "Best Buy defies retail doldrums, posting higher sales," *Wall Street Journal*, May 25, 2017.

[354] Paul Xie, *Suning-brick and mortar retailer challenged by e-commerce*, November 17, 2016; and *Suning plans to maintain 'cloud store' expansion*, Planet Retail, November 5, 2015.

[355] *Mango TV publishes its new program: many homemade TV shows*, Jiemian, May 6, 2016 (http://www.jiemian.com/article/639147.html).

[356] Anne Grosse-Ophoff, Saskia Hausler, Kersten Heineke, and Timo Möller, "How shared mobility will change the automotive industry," *McKinsey Quarterly*, April 2017.

[357] Jacques Bughin and Nicolas van Zeebroeck, "The best response to digital disruption," *MIT Sloan Management Review*, summer 2017, April 6, 2017.

[358] Clare Jim, *Developers, funds target China demand for co-working space amid startup boom*, Reuters, December 14, 2016.

Adopt the approach of venture capital and private equity players

In the face of digital disruption, companies need to take a venture capital approach to new business lines, focusing on enabling growth while ensuring that existing business lines get a private equity–style workout to ensure that revenue and profit are sustained. This is not easy. Managing corporate venture capital and incubating new business ideas entail huge challenges. Investment always involves risks, and betting on future trends requires different types of capability—and even higher capability—than many traditional companies possess.

In reality, incumbents tend to become impatient to boost profits in new businesses but are less activist about core businesses that may already generate healthy cash flow. GE Ventures, GE's venture capital arm launched in 2013, has invested in more than 60 software, energy, health-care, and advanced manufacturing startups. This activity may result in a large payoff for the companies in which it has invested as well as GE's customers.[359] At the same time, GE has been restructuring its traditional portfolio, unloading assets in real estate and other units to focus on core competencies. Intel's venture capital arm has invested more than $11 billion in over 1,300 companies in 55 countries in a bid to bolster its business ecosystem and improve its business pipeline.[360] Intel has also been pursuing global restructuring initiatives to enhance productivity and execution.[361] In China, since 2010, Lenovo has launched startup funds and invested heavily in new technologies such as facial recognition, biometrics, cloud computing, big data, AI, robots, and other internet services. The company also has an incubator program, which allows some units to operate as independent subsidiaries; examples include file-sharing application SHAREit, Lenovo Cloud, and Lenovo Connect.[362] At the same time, Lenovo has focused on restructuring initiatives so that it remains focused on its existing customers.[363]

Be the default choice of customers

Ensuring that a product or service is the default choice for customers is another component of a bold strategy. We have seen examples of this approach in China's consumer and retail and automotive and mobility sectors. Research on consumer behavior shows that presenting one option as a default increases the chance that it will be chosen.[364] Consumers of experimental automated retail store Amazon Go choose products and then leave, knowing that their default payment option will be billed automatically. In China, Alibaba has established an experimental shop that has no cashiers and does not accept cash. Customers can leave the store through a one-meter-long gate that charges their default Alipay account automatically, using facial recognition technology.[365] Similarly, ride-hailing company Didi Chuxing charges customers using a default payment option on completion of a trip. These practices mean that payment companies, including incumbent banks and credit card issuers, could face significant loss of revenue and customers unless they are selected as default options. Another example is the battle within AI algorithms. When consumers order, say, paper towels through an AI-enabled shopping assistant, they may order a particular brand as a default (or an optimized result generated by the algorithm) unless they specify another brand. This can put brand-name companies at risk. Therefore, building a clear identity and loyalty with end customers is key.

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[359] Company websites (www.geventures.com).

[360] *Investing in Breakthrough: Corporate venture capital*, Volans.

[361] Jana Kasperkevic, "Intel announces 12,000 job cuts in global restructuring initiative," *The Guardian*, April 19, 2016.

[362] Jon Russell, *Lenovo is launching a new $500 million startup fund*, TechCrunch, May 6, 2016.

[363] Yuan Yang, "Lenovo announces overhaul and renewed focus on China," *Financial Times*, May 16, 2017.

[364] Ned Welch, "A market's guide to behavioral economies," *McKinsey Quarterly*, February 2010.

[365] *Unmanned supermarket Tao Cafe appears in Hangzhou, applying IOT for payments*, Sohu, July 11, 2017 (http://www.sohu.com/a/156192457_120809).

USE THE POWER OF CHINA'S VAST DIGITAL ECOSYSTEM

Another factor that argues for businesses to be bold in China is the commanding market share of giant digital-platform players compared with other economies. The BAT companies have a monthly user base of 500 million to 900 million a month, offer cross-sector solutions through superapps, and have played a vital role in providing capital and talent to startups, as we discussed in Chapter 1. Other companies have benefited from investment, information sharing, and partnership with these companies and their alumni. But BAT's dominance poses challenges, too. Companies working in China should figure out how to maintain healthy relationships with the big digital platforms, simultaneously collaborating with them to tap into their resources and protecting their own core businesses. We note that the choices that companies make are likely to be different if they are largely business-to-business or mainly business-to-customer—each of which has different buying factors and cycles. Data are siloed in many pools in China, and different types of data are often regulated differently. Thus, platform players in consumer segments may not have access to data from government or SOEs in B2B areas.

Collaborate with digital platforms

China's largest digital platforms are strengthening their roles as central gateways to millions of customers. Companies establishing partnerships with these formidable market leaders need to be clear on the scope of that collaboration. Should it include product development, marketing, or business operations, for example? They also need to consider what specific resources they want from the platform and what they are prepared to contribute in return. A number of partnerships have emerged that have made different choices. One partnership is between Jahwa, one of the largest Chinese beauty care brands, which has established a joint big-data lab with Alibaba focused on innovating new products. Using advanced analytics backed by large volumes of consumer and transaction data from Alibaba's e-commerce business, Jahwa has shortened time to market for new products from 15 to 13 months and has expanded its product portfolio from 389 stock-keeping units in 2015 to around 500 units in 2016.[366] In its collaboration with WeChat, BMW chose to focus on marketing by delivering tailored advertisements to target consumer segments through WeChat Moments. Its advertisements gained more than 30 million impressions within 3.5 hours of going live, creating considerable buzz on social media.[367] Local commercial bank China Guangfa Bank developed its plan for expanding branches using location-based services provided by Baidu Maps, a platform that processes more than ten billion pieces of location data every day. This collaboration enabled China Guangfa to decide where to expand offline branches and even individual ATMs in a way backed by detailed data.[368] Chinese smartphone company Meizu partnered with JD.com to make use of the e-commerce giant's considerable supply-chain capabilities. It used JD.com's inventory-planning system to deliver the new Meizu Note5 phone to customers in Beijing, Guangzhou, and Shanghai within one hour of purchase on the day the handset was released.[369]

The potential power of such partnerships is not in doubt, but they must be handled carefully. Companies need to ensure that they protect their "core," such as brand integrity and relationships with end consumers, and that they are able to use the data generated to develop attractive and attractively priced products that consumers will want to buy—and, in the process, protect themselves to a degree from disintermediation. Three aspects

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366 *Alibaba collaborates with Shanghai Jahwa Corporation to build the first big data lab about daily cosmetics*, China Securities, December 21, 2015 (http://www.cs.com.cn/sylm/jsbd/201512/t20151221_4866954.html).

367 *BMW delivers tailored advertisements to target consumer segments through WeChat Moments*, Sohu, June 8, 2017 (http://www.sohu.com/a/147034019_610532).

368 *Understanding the collaboration between Baidu and China Guangfa Bank*, Hexun, September 22, 2014 (http://tech.hexun.com/2014-09-22/168728893.html); and *Baidu publishes the smart business platform to boost industrial upgrading*, NetEase News, September 25, 2014 (http://news.163.com/14/0925/03/A6V6L1F500014Q4P.html).

369 *Meilan Note 5 is issued in JD arrives within one hour*, kejixun, December 7, 2016 (http://www.kejixun.com/article/161207/257668.shtml).

are worth considering as companies consider collaborating with other players in the digital ecosystem:

- **Align long-term strategic interests.** Chinese digital platform companies have their own strategic agendas—innovation, globalization, expansion into business-to-business segments, and inclusive growth for SMEs, for example. Companies seeking collaboration need to consider how to align their interests with those of a prospective partner, at least to some degree. They need to ask themselves whether they understand the potential partner's strategic agenda, how they might contribute, and what they expect in return.

- **Prepare contingency plans.** A company collaborating with a digital platform needs to manage the partnership actively at every stage, monitoring what works and what doesn't, and being mindful of changing circumstances that may erode the business case for participating (or, conversely, strengthen the business case for broadening the collaboration). Only through hands-on management will the company be able to keep track of changes in the strategy and common interests of the collaboration—changes that are highly likely in such a dynamic digital economy. Indeed, the case for collaboration may even weaken as the interests of the partners diverge. It therefore makes sense to have contingency plans in place that adjust the way the partnership works, or even, in an extreme case, manage its breakup. Companies need to try to anticipate under what circumstances interests may diverge, what the downside risks would be and how large, and how to cultivate alternative strategies.

- **Adopt a war-game mentality.** A useful tool that companies may use to simulate changing equilibrium is war gaming their strategic responses to different scenarios, taking into account the thinking, plans, and actions of different stakeholders and competitors. In this war game, they can simulate developments in consumer behavior, technology, and regulation, how partners and competitors might react, and, in turn, how they should respond.

Create an ecosystem

Incumbents often already have substantial assets, which they can leverage to create their own ecosystem as an alternative and in addition to partnerships. Across sectors and geographies, we are seeing this happen in practice.

For instance, US-based multinational GE is promoting its own industrial IoT platform Predix, which enables industrial players to connect machines, collect data, and run analytics and applications to improve the efficiency of their operations. GE has also created an ecosystem of applications by joining forces with industrial players through application programming interfaces.[370] In logistics, incumbents can maintain substantial scale advantages by forming alliances with other established companies to bolster their control over offline assets including trucks, warehouses, and sorting centers. In finance, Chinese company Ping An has built an ecosystem around many business areas, including P2P lending platforms, online real estate, crowdfunding, health care, and auto financing. In the automotive sector, where dominant online players have yet to emerge, SAIC built an O2O platform so that it could own its relationship with end customers through their decision journeys. In 2014, the company launched Chexiang, which provides full coverage of "evaluation, purchase, maintenance, and resale" for more than 1,000 dealers and five million existing car owners.[371] Huawei has been developing a digital service ecosystem using its telecommunications assets. The company offers a unified open digital platform that helps operators create successful partnerships and innovate; the platform offers many business models, including

[370] Predix (https://www.ge.com/digital/predix).
[371] SAIC Chexiang (http://www.chexiang.com/gycx/about.shtml).

direct billing, revenue share, pay-as-you-use, and pay-as-you-go. Huawei also has eight hosting centers around the world—an effective way to build a digital ecosystem—and a global partnership alliance that provides services from partner recruitment to service promotion to operational support.[372]

MAXIMIZE VALUE FROM ANALYTICS BY USING CHINA'S MASSIVE DATA POOLS

Gathering and using data is increasingly a core competitive advantage for companies, and embracing this core part of digitization is vital.[373] Data and analytics are already shaking up many industries, and, as adoption reaches critical mass, the impact is likely to become even more pronounced. China is superbly positioned because of the huge scale of data gathered every day from 731 million internet users, five billion online search queries on Baidu, an average of 66 minutes of WeChat usage, and 175 million Alipay transactions.[374] Scale is not the only issue. There are arguably more opportunities to monetize data in China than in other economies given a relatively accepting view among Chinese consumers about sharing their data. As we noted in Chapter 3, 64 percent of Chinese automotive consumers surveyed said that they would be willing to pay for subscriptions to connected-car services, compared with 26 percent in the United States and only 8 percent in Germany.[375] These two ingredients—scale of data pools and opportunity to monetize—leave huge scope for companies in China to innovate ways to maximize the potential of data and analytics.

Start from the business perspective

Data analytics is complex and technical, and executives may be tempted to leave it to the experts. However, it is important that the business imperative is clear from the start—in other words, the data and its analysis must have a purpose that serves the business. It is important that the CEO and other top executives articulate the purpose behind analytics across the organization that will be using the insights to develop products and services and to improve customer service.[376]

Break silos

The full power of data cannot be realized unless they are shared and pooled as widely as possible within a company. It is therefore vital that companies break down resistance to sharing proprietary data within different business units by providing effective incentives.[377] There are challenges. For instance, software applications may well have been written for different business units at different times by different vendors, making pools of data incompatible. At US telecom company AT&T, the analytics team took over 60 different silos of information related to direct-material purchasing, analyzed the combined data pool to look at new customer relationships, and used machine learning to identify very large potential for efficiencies in the way the company procured materials.[378] In China, digital companies are moving fast to aggregate data so that they can be used effectively. Tencent built a big-data platform that can access information from different applications such as QQ, WeChat, video, and games in real time. The platform has access to more than three million websites as well as 500,000 apps, which can be fed into analytics and machine-learning engines.[379] Ctrip, an online travel service provider, constructed a real-time data-computing platform that integrates data from more than 20 operating departments,

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[372] *Building a digital service ecosystem by leveraging telecom assets*, Huawei Digital SDP, white paper for operators.

[373] *The age of analytics: Competing in a data-driven world*, MGI and McKinsey Analytics, December 2016.

[374] Based on latest available statistics and company announcements.

[375] *Competing for the connected customer—perspectives on the opportunities created by car connectivity and automation*, McKinsey & Company Advanced Industries, September 2015.

[376] Helen Mayhew, Tamim Saleh, and Simon Williams, "Making data analytics work for you—instead of the other way around," *McKinsey Quarterly*, October 2016.

[377] *How advanced analytics can drive productivity*, McKinsey & Company podcast, August 2016.

[378] *How companies are using big data and analytics*, McKinsey & Company interview, April 2016.

[379] Tencent (http://bigdata.qq.com/).

including two important businesses: hotels and airline tickets. Using this integrated platform, Ctrip can design customized travel plans for tourist attractions and travel agencies as well as individuals.[380]

Monetize data

Gathering data is only the first stage—they then need to be analyzed and used to develop corporate strategy. Companies that incorporate data-driven insights into their decision making will maximize value from their data lakes. Alibaba gathers a huge amount of data through its vertically and horizontally integrated services, from shopping to movies, finance, and logistics. It then refines and analyzes the data and feeds them back to merchants who can refine the products sold through Alibaba's platforms.[381] The Data Beacon Project, which provides big data services for business-to-business customers, allows SF Express to gather data from its e-commerce platforms, its 300,000 express-delivery workers, and its more than 23,500 offline stores. The company then uses the information gathered to offer data analysis and business insights to other e-commerce players, suppliers to SMEs, and local business owners.[382] Leading commercial bank China Merchants Bank used analytics to substantially improve its loan-application processes and enhance its competitiveness in the face of fintech attackers. The bank's analytics platform gathers data on transactions and credit histories from internal and external sources, and uses statistical models to build risk profiles to determine loan applicants' qualifications and loan amounts. As a result, the time it takes for the bank to issue a loan has plunged from three days to one minute.[383]

BUILD AN AGILE ORGANIZATION FOR DIGITAL TRANSFORMATION

90%
of Chinese executives surveyed said AI would change their industries fundamentally

Digital disruption is accelerating. This type of disruption typically happens in the form of an S-curve, but in reality, whether a development will prove to be a fad and die down or become an entrenched trend is difficult to predict.[384] In many cases, companies recognize disruption only after it happens. It is therefore important to build an agile organization and culture that can adapt rapidly to changes. The need for agility may be even more pressing in Chinese companies, which still tend to have strong hierarchies. According to McKinsey's Organizational Health Index, Chinese firms score low on employee motivation and have a tendency to "throw money at a problem."[385]

Build an agile organization

To become agile, companies need to be able to recognize and overcome typical ways that they have responded (or failed to respond) in the past. In a fast-changing, digitizing world, companies need to try to learn to act before it is obvious that action is needed. Global bank ING has put together 350 nine-person squads that assemble IT and commercial employees and test what they might offer customers. ING has done away with a promotion and pay structure that rewarded managers based on the size of their projects or team. The company says that what matters today is how people deal with knowledge. These changes have helped ING improve time to market, boosted employee engagement, and increased productivity.[386] In China, Haier has encouraged employees to start their own microenterprises, and about 200 internal startups have formed. Instead of a top-

[380] *Ctrip real-time big data platform practice*, Ctrip Technical Center, August 30, 2016 (http://techshow.ctrip.com/archives/1254.html).

[381] Louise Lucas, "Alibaba taps user data to drive growth spurt," *Financial Times*, June 22, 2017.

[382] *Fast and furious—how SF Express creates business opportunities using digital technology*, Harvard Business School, November 16, 2016.

[383] "Big data technology assists CMBC with peer-to-peer lending," People's Daily Online, May 18, 2015 (http://finance.people.com.cn/money/n/2015/0518/c218900-27018079.html).

[384] Chris Bradley and Clayton O'Toole, "An incumbent's guide to digital disruption," *McKinsey Quarterly*, May 2016.

[385] Based on McKinsey's Global Database of OHI in 2015, with 737 organizations and more than 1.2 million respondents.

[386] "ING's agile transformation," *McKinsey Quarterly*, January 2017.

down pyramidal structure, the company aims to put in place a number of flat, interactive business platforms.[387]

Ensure support from the top

Digital transformation needs active support not only from the CEO but also from other top executives. Experience suggests that a chief digital officer should be put in charge of the full digital agenda. The entire organization needs to be attuned to the digital imperative. In McKinsey's 2015 global executive survey, only 17 percent of directors said their boards were sponsoring digital initiatives. In the 2013 global executive survey, just 16 percent of executives said that they fully understood how the industry dynamics of their companies were changing due to digitization.[388] In a McKinsey survey of Chinese executives on the impact of AI, 90 percent of respondents agreed that AI would fundamentally change their industries, but more than 40 percent of respondents said that they did not see their company's CEO making AI a strategic priority. As a result, over 60 percent of executives in the survey said that they did not believe that their company had made satisfactory progress on its AI strategy over the preceding year.[389]

Nurture talent

Sweeping digitization means that companies will need different skill sets. Many will be hindered by a shortage of the right talent. Apart from specialized scientists to undertake data analytics, companies need people who combine technical know-how with business acumen to ensure that they can realize the full business potential of data. These people are commonly known as business translators, and they are difficult to find and retain. Some organizations have developed innovative, venture capital–like strategies for finding and recruiting the people they need. For instance, Staples has built an e-commerce innovation center in Cambridge, Massachusetts, to improve its recruitment of technology talent from nearby Harvard University and the Massachusetts Institute of Technology. The company has also bought conversion-marketing startup Runa to act as a talent hub on the West Coast of the United States.[390] Being physically close to pools of talent is an option adopted by many companies. Baidu has set up big data labs in Beijing, Shenzhen, and Silicon Valley, all technological hubs that attract top academic and entrepreneurial talent from around the world. American Express is headquartered in the financial-services powerhouse of New York City but also has a big data and cloud computing technology center in Silicon Valley. Companies need to excite talented people about the opportunities that are available. In that spirit, Tencent established an AI lab in Shenzhen, where computer scientists and engineers work on fundamental research and practical applications of AI. Now Tencent is planning to tap into the supply of US tech talent by opening its first US-based AI lab in Seattle.[391] Its massive data from hundreds of millions of users and various types of applications are viewed as one of the key reasons that talented people join the company.

[387] *Becoming a digital organization: Haier's experience*, MIT Digital, January 13, 2016.

[388] Hugo Sarrazin and Paul Wilmott, "Adapting your board to the digital age," *McKinsey Quarterly*, July 2016. Also see *Cracking the digital code*, McKinsey Global Survey results, September 2015; and *Improving board governance*, McKinsey Global Survey results, August 2013.

[389] *The rise of the machines: How Chinese executives think about developments in artificial intelligence*, McKinsey & Company, December 2016.

[390] *Digitizing the consumer decision journey*, McKinsey & Company, June 2014.

[391] Yuan Yang, "China's Tencent to open first US-based AI laboratory," *Financial Times*, May 2, 2017.

Only
44%
of executives in Chinese state-owned enterprises said they were prepared for Industry 4.0

DIGITIZE OPERATIONS BASED ON A SOLID TRANSFORMATION PROGRAM

The scope for transformative digitization programs for companies in China is extremely large given the fact that the economy is still growing at a healthy clip, that digital technologies are changing the character of the economy so quickly, and that so many businesses are underprepared.

In June 2016, McKinsey surveyed 130 companies in China (including multinational corporations operating there) to gauge readiness for the digital era. Chinese manufacturers, particularly private companies, were more optimistic than their counterparts in Germany, Japan, and the United States about the transformative potential of Industry 4.0. Nevertheless, Chinese manufacturers described themselves as less prepared than executives in the other countries to promote Industry 4.0 initiatives; only 44 percent of executives from SOEs said that they were prepared, compared with 71 percent in the United States and 68 percent in Germany. The survey revealed that only 9 percent of companies that responded have assigned responsibilities for Industry 4.0 initiatives, compared with more than one-third in the United States and Germany. Only 6 percent of Chinese companies surveyed said that they have put in place a clear road map toward digitization, compared with the more typical 20 percent among companies from developed economies surveyed.[392]

Chinese companies should consider current thinking on best practices in digital transformations to ready themselves as digitization sweeps through the economy. McKinsey finds that companies must be open to radical reinvention in order to establish significant and sustainable new sources of revenue.[393] Companies can start with targeted digital levers to achieve specific operational objectives. For instance, Mengniu, a leading Chinese dairy brand, has deployed digital operations in its farms and milk production. It has used a range of digital manufacturing systems, including a manufacturing execution system, a laboratory information-management system, and product-lifecycle management to help manage its herds of dairy cattle, production lines, transportation, and delivery to consumers. The laboratory information system has reduced the time it takes to determine milk quality by up to 25 percent because 105 procedures are now automatic. Each cow has a smart belt on the ear to record its feeding, milking, and sleeping data, which the company uses to manage the herd.[394]

The largest impact can be achieved through a comprehensive and structured transformation program. One manufacturer in Greater China launched its digital transformation with three bold steps. First, it identified and then prioritized value drivers. The company assessed the potential value and feasibility of 100 digital and IoT value drivers, an exercise that resulted in prioritizing 17 initiatives with high impact and feasibility. Second, the company established three key enablers. One is a digital performance management system with sensors that record information from numerous machines, an information hub displaying real-time reports with root-cause analysis, and reports offering solutions based on a database of company knowledge. Another is a digital center of excellence—a group of experts and specialists to lead various digital transformation projects. Finally, the company has put in place an extensive IT infrastructure, including a data lake, analytics solutions, and hardware and software. The third step was implementing priority initiatives including labor efficiency, asset productivity, output quality, and inventory management. The company expects these initiatives to improve operating profit by 30 percent if fully implemented, with payback of its initial investment in three to four years.

[392] Forest Hou, Arthur Wang, and Ting Wu, "A digital upgrade for Chinese manufacturing," *McKinsey Quarterly*, May 2017.

[393] *From disrupted to disrupter, Reinventing your business by transforming the core*, McKinsey & Company, February 2017.

[394] *Mengniu Dairy pushes the innovation of the Chinese dairy industry*, China News, June 9, 2017 (http://www.chinanews.com/business/2017/06-09/8246433.shtml).

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Chinese cities have initiated smart-city pilot projects

ENGAGE WITH CHINA'S POLICY AND REGULATION

Digitization of China's economy and industries is a priority for the government, which has made clear its intention to continue to drive digital initiatives, facilitate investment, and create new markets. It is in all companies' interests to ensure that they keep abreast of policy and regulatory developments and understand what they imply. This will enable the companies to craft business opportunities accordingly, scale them up, and take them to the world.

Companies should make it their business to gather intelligence on various government-initiated projects at the provincial, city, and even district level, and assess whether getting involved is feasible and desirable for them.

We are already seeing an increasing level of engagement by companies in smart-city projects in China, where 290 cities have initiated smart-city pilot projects; more than 300 cities have signed smart-city construction agreements with IT companies, including the three major Chinese telecommunications companies as well as Ant Financial and Tencent.[395] Such projects present a range of digital opportunities including, for instance, mobile-payment-based toll fees to cloud-based hospitals, facial-recognition-based security solutions, IoT–based green buildings, and e-learning programs. Cisco Systems announced an investment of 20 billion renminbi ($2.9 billion) in Guangzhou's smart-city project as part of the company's goal to build the largest platform of internet R&D and intelligent operations outside the United States.[396] As companies accumulate know-how and scale up solutions in China, they can then use that experience and expertise to help develop digital in other emerging economies embarking on this journey—and in the process use different environments to experiment and develop large-scale and systematic solutions. ZTE, a Chinese technology company, has been involved in more than 150 smart-city projects across China. In 2016, as part of China's One Belt, One Road initiative, it launched a Data Belt, Information Road strategy designed to strengthen similar collaboration with other countries.[397]

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China's most successful digital giants are already making their presence felt around the world. But most of China's potential to become a true digital economy and a global force on the digital landscape is yet to come. The internet giants dominate their respective markets and are developing a much broader ecosystem with considerable support from government policy; even traditional companies are now beginning digital transformations, building their own ecosystems, and going global. The scope for huge value shifts and creation is substantial, at up to 45 percent of the revenue pools of four key sectors. A combination of wide-ranging inefficiencies across sectors today, enthusiasm among Chinese consumers for digital tools, and massive potential for commercialization points to further digitization in China on a truly global scale.

[395] *China's "smart" cities to number 500 before end of 2017*, The State Council of the People's Republic of China, April 21, 2017.

[396] "China's major technological breakthroughs win 'thumb-up' from international community," *China Daily*, May 22, 2017.

[397] *ZSmart "Data Belt, Information Road" strategy—to innovate a regional cooperation platform to connect the Smart Nation and Smart cities*, ZTEsoft, May 2, 2016.

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BIBLIOGRAPHY

A

AliResearch, *AliResearch and Global Smart Logistics Summit 2017*, May 22, 2017 (http://i.aliresearch.com/img/20170522/20170522100820.pdf).

AliResearch, *Three future trends in the e-commerce logistics industry*, May 12, 2016 (http://www.aliresearch.com/blog/article/detail/id/20931.html).

B

Bagwell, Kyle, and Robert W. Staiger, *Reciprocity, non-discrimination and preferential agreements in the multilateral trading system*, National Bureau of Economic Research working paper number 5932, February 1997.

Baily, Martin Neil, and Nicholas Montalbano, *Why is productivity growth so slow? Possible explanations and policy responses*, Brookings Institution, September 2016.

Bauer, Matthias, Erik van der Marel, Hosuk Lee-Makiyama, and Bert Verschelde, *The costs of data localisation: A friendly fire on economic recovery*, ECIPE occasional paper number 3/2014, European Centre for International Political Economy, 2014.

Berger, Thor, Chinchih Chen, and Carl Benedikt Frey, *Drivers of disruption? Estimating the Uber effect*, Oxford Martin Programme on Technological and Economic Change, January 23, 2017.

Bi, Yufang, Runlin Gao, Anushka Patel, Steve Su, Wei Gao, Dayi Hu et al., "Evidence-based medication use among Chinese patients with acute coronary syndromes at the time of hospital discharge and 1 year after hospitalization: Results from the Clinical Pathways for Acute Coronary Syndromes in China (CPACS) study," *American Heart Journal*, volume 157, issue 3, March 2009.

Black Book Market Research, *State of the enterprise health information exchange industry*, 2015 User Survey, February 2015.

Bloomberg New Energy Finance, *Car sharing in Europe: Automakers take the spotlight*, September 2016.

Bloomberg New Energy Finance, *Electric vehicle outlook 2017*, July 2017.

Breene, Keith, *This is the extent of the demographic digital divide*, World Economic Forum, March 22, 2016.

Broderick, Andrew, and David Lindeman, "Scaling telehealth programs: Lessons from early adopters," Case Studies in Telehealth Adoption, The Commonwealth Fund, January 2013.

Brown, Rachel, *Beijing's Silk Road goes digital*, Council on Foreign Relations, June 6, 2017.

Brynjolfsson, Erik, and Joo Hee Oh, *The attention economy: Measuring the value of free digital services on the internet*, research paper presented at the 33rd International Conference on Information Systems, Orlando, 2012.

Byrne, David M., John G. Fernald, and Marshall B. Reinsdorf, *Does the United States have a productivity slowdown or a measurement problem?* Federal Reserve Bank of San Francisco, working paper 2016-03, April 2016.

C

CBNData, *2016 intelligent mobility big data report*, January 12, 2017 (http://www.cbndata.com/report/93).

Center for Automotive Research, *The impact of new mobility services on the automotive industry*, August 2016.

China Academy of Information and Communications Technology, *White paper on digital economy development*, July 2017 (http://www.chinadaily.com.cn/business/2017-07/20/content_30179729.htm).

China Institute of Telecommunications, *Over 500 million volume of shipping for Chinese mobile phones, accounting for 90% in 2016*, January 11, 2017 (http://www.199it.com/archives/556239.html).

China Insurance Regulatory Commission, *2016 insurance statistics report*, February 22, 2017 (http://www.circ.gov.cn/web/site0/tab5257/info4060001.htm).

China Internet Network Information Center, *China statistical report on internet development*, January 2017 (http://cnnic.cn/hlwfzyj/hlwxzbg/hlwtjbg/201701/P020170123364672657408.pdf).

China Joint Study Partnership, *Deepening health reform in China: Building high-quality and value-based service delivery: Policy summary*, World Bank, 2016.

China Ministry of Commerce, *13th Five-Year Plan for the trade and logistics industry*, February 8, 2017 (http://www.mofcom.gov.cn/article/guihua/201702/20170202511705.shtml).

China Ministry of Education, *13th Five-Year Plan for educational informationization*, June 7, 2016 (http://www.moe.gov.cn/srcsite/A16/s3342/201606/t20160622_269367.html).

China Ministry of Education, *2005 national education expenditure implementation statistics bulletin*, December 29, 2016 (http://www.moe.edu.cn/jyb_sjzl/s5990/201612/t20161219_292432.html).

China Ministry of Education, *2015 national education expenditure implementation statistics bulletin*, December 29, 2016 (http://www.gov.cn/shuju/2016-11/10/content_5131034.htm).

China Ministry of Education, *An inexorable trend in Chinese education reform of innovation and entrepreneurship*, September 9, 2017 (http://www.moe.gov.cn/jyb_xwfb/xw_fbh/moe_2069/xwfbh_2017n/xwfb_2017090801/mtbd_2017090801/201709/t20170911_314104.html).

China Ministry of Health, *Principles to strengthen the construction of digital health care*, June 15, 2012 (http://www.moh.gov.cn/mohbgt/s6693/201206/55102.shtml).

China Ministry of Human Resources and Social Security, *Social insurance has covered the whole of society*, December 14, 2016 (http://www.mohrss.gov.cn/SYrlzyhshbzb/dongtaixinwen/buneiyaowen/201612/t20161214_261978.html).

China National Development and Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce, *Vision and actions on jointly building Silk Road Economic Belt and 21st-century maritime Silk Road*, March 2015.

China National Health and Family Planning Commission, *Healthy China 2030 plan*, August 25, 2016 (http://www.nhfpc.gov.cn/xcs/wzbd/201610/21d120c917284007ad9c7aa8e9634bb4.shtml).

China Road Transport Association, *Transportation statistics bulletin of the China Road Transport Association*, May 12, 2016 (http://www.crta.org.cn/article-2349.html).

China State Information Center, *China's sharing economy development report*, February, 2017 (http://www.sic.gov.cn/archiver/SIC/UpFile/Files/Default/20170306164936642988.pdf).

China State Post Bureau, *Notifications of consumer complaints in the mail business*, July 13, 2017 (http://www.gov.cn/xinwen/2017-07/13/content_5210126.htm).

China Trade in Services, *Freight forwarding and logistics industry develops smoothly*, August 10, 2017 (http://tradeinservices.mofcom.gov.cn/g/2017-08-10/336924.shtml).

Chinese Hospital Association Information Management Committee, *Survey on digitization of Chinese hospitals*, September 2015.

Currie, Janet, Wanchuan Lin, and Juanjuan Meng, "Addressing antibiotic abuse in China: An experimental audit study," *Journal of Development Economics*, volume 110, September 2014.

Cyber Administration of China, *National cyberspace security strategy*, December 27, 2016 (http://news.xinhuanet.com/politics/2016-12/27/c_1120196479.htm).

E

eMarketer, "Understanding China's O2O commerce marketplace," August 22, 2016.

European Commission, *Education and training 2020*, May 2009.

European Commission and World Health Organization, *China policies to promote local production of pharmaceutical products and protect public health*, 2017.

F

Fung Business Intelligence Centre, *Logistics industry in China*, August 2013.

G

Gartner, *2016 CIO agenda: A China perspective*, February 2016.

Global Health Workforce Alliance and World Health Organization, *A universal truth: No health without a workforce: Third Global Forum on Human Resources for Health report*, November 2013.

H

Hajli, Nick, "A study of the impact of social media on consumers," *International Journal of Market Research*, volume 56, issue 3, May 2014.

Hospital Management Institution of Fudan University, *China best hospitals rankings*, 2015 (http://www.fudanmed.com/institute/news222.aspx).

Hou, Jianlin, and Yang Ke, "Addressing the shortage of health professionals in rural China: Issues and progress," *International Journal of Health Policy Management*, volume 4, issue 5, May 2015.

I

International Labour Organisation, Organisation for Economic Co-operation and Development, and World Bank Group, *The contribution of labour mobility to economic growth*, joint paper for G20 Labour and Employment Ministers' meeting, Ankara, Turkey, September 3–4, 2015.

International Telecommunication Union and UNESCO, *The state of broadband 2016*, September 2016.

iResearch, *2015 China online shopping report*, July 27, 2015 (www.iresearchchina.com/content/details8_19346.html).

iResearch, *2017 China's sharing bicycle industry report*, March 22, 2017 (http://report.iresearch.cn/report/201703/2961.shtml).

J

Jiang, Lixin, Harlan M. Krumholz, Xi Li, Jing Li, and Shengshou Hu, "Achieving best outcomes for patients with cardiovascular disease in China by enhancing the quality of medical care and establishing a learning health-care system," *The Lancet*, volume 386, number 10002, October 10, 2015.

Jiangsu Provincial Government, *The plan of training program for professional skills*, March 2017.

K

Knight, Will, "The self-driving project that could help China leapfrog the West," *MIT Technology Review*, July 5, 2017.

L

Lee, Hau, Barchi Gillai, Yiwen Chen, and Sonali Rammohan, *U.S.-to-China B2C e-commerce: Improving logistics to grow trade*, Stanford Value Chain Innovation Initiative white paper, Stanford Graduate School of Business, August 2016.

Leviathan Security Group, *Quantifying the cost of forced localization*, 2015.

Lo, Winnie, *E-commerce reshaping line haul delivery*, Fung Business Intelligence, June 2017.

Londoño-Kent, Pilar, *Freight transport for development toolkit: Road freight*, World Bank and UK Department for International Development, 2009.

M

Ma, Jin, *China's public hospital governance reform: Case study of Shanghai*, unpublished case study commissioned by the World Bank, 2015, cited in *Healthy China: Deepening health reform in China: Building high-quality and value-based service delivery*, policy summary, China Joint Study Partnership, 2016.

Mai, Andreas, and Dirk Schlesinger, *Connected vehicle insurance: The business of preventing crashes*, Cisco, April 2011.

Min, Han, *The new progress on lifelong learning education policies in China*, National Center for Education Research Development, ASEM Lifelong Learning Research Hub Network 4 meeting, East China Normal University, December 12, 2011.

Min, Yan, Li-Xin Jiang, Li-Jing L. Yan, Lin-Hong Wang, Sanjay Basu, Yang-Feng Wu, and Randall S. Stafford, "Tackling China's noncommunicable diseases: Shared origins, costly consequences and the need for action," *Chinese Medical Journal*, volume 128, issue 76, March 20, 2015.

Morey, Timothy, Theodore Forbath, and Allison Schoop, "Customer data: designing for transparency and trust," *Harvard Business Review*, May 2015.

Morey, Timothy, and Rainer Wessler, *Designing with data in China: Opportunity and risk*, Design Mind, February 28, 2013.

Mossialos, Elias, Yanfeng Ge, Jia Hu, and Liejun Wang, *Pharmaceutical policy in China: Challenges and opportunities for reform*, Observatory Studies Series number 45, World Health Organization, 2016.

N

National Health and Family Planning Commission, *Healthy China 2030 Plan*, August 25, 2016 (http://www.nhfpc.gov.cn/yzygj/s3593/201512/a335bd9490164b928f27276b0161daa9.shtml).

National Health and Family Planning Commission, *Nutrition and chronic conditions of Chinese residents report*, June 30, 2015.

National People's Congress of the People's Republic of China, *Law of the People's Republic of China on Cybersecurity*, November 7, 2016 (http://www.npc.gov.cn/npc/xinwen/2016-11/07/content_2001605.htm).

O

OECD Directorate for Financial and Enterprise Affairs, Competition Committee, *The digital economy*, February 7, 2013.

P

Panizzon, Marion, Nicole Pohl, and Pierre Sauvé, eds., *GATS and the regulation of international trade in services*, Cambridge University Press, 2008.

R

RDPAC (R&D-Based Pharmaceutical Association Committee), *The faces of innovation: Meeting the challenge of diabetes*, 2016.

Risk Based Security, *2016 data breach trends: Year in review*, January 2017.

Rochet, Jean-Charles, and Jean Tirole, "Platform competition in two-sided markets," *Journal of the European Economic Association*, volume 1, issue 4, June 2003.

Rollins, John W., *U.S.-China Cyber Agreement*, CRS Insight, October 16, 2015.

Ruan, Sherry, Jacob O. Wobbrock, Kenny Liou, Andrew Ng, and James Landay, *Speech is 3x faster than typing for English and Mandarin text entry on mobile devices*, Stanford University, August 2016.

S

Schreiber, Zvi, *Transparency and overcapacity: Where freight is going in 2017*, Supply Chain Brief, 2017.

Stanford Value Chain Innovation Initiative, *Technological disruption and innovation in last-mile delivery*, Stanford Graduate School of Business white paper, June 2016.

State Council of the People's Republic of China, "China to improve education during 13th Five-Year Plan period," January 19, 2017.

State Council of the People's Republic of China, "China unveils Internet Plus action plan to fuel growth," press release, July 4, 2015.

State Council of the People's Republic of China, *China's big data regulation to boost healthcare, security*, May 2, 2017.

State Council of the People's Republic of China, *China's focus on Internet Plus governance*, February 1, 2017.

State Council of the People's Republic of China, *Complete the intellectual property protection system*, November 27, 2016 (http://www.gov.cn/zhengce/2016-11/27/content_5138533.htm).

State Council of the People's Republic of China, *Several opinions on the establishment of an intellectual property strong country in the new situation*, number 71, 2015.

Sylvia, Sean, Yaojiang Shi, Hao Xue, Xin Tian, Huan Wang, Qingmei Liu, Alexis Medina, and Scott Rozelle, "Survey using incognito standardized patients shows poor quality care in China's rural clinics," *Health Policy and Planning*, volume 30, issue 3, April 2015.

Syverson, Chad, *Challenges to mismeasurement explanations for the U.S. productivity slowdown*, NBER working paper number 21974, February 2016.

T

Tencent Research Institution, *The 2017 China "Internet Plus" digital economy index*, April 2017 (http://en.xfafinance.com/html/Dont_Miss/2017/325250.shtml).

Thulin, Per, *Labor mobility, knowledge diffusion and regional growth*, CESIS Electronic working paper series, number 209, December 2009.

U

United Nations Department of Economic and Social Affairs, *United Nations e-government survey 2016: E-government in support of sustainable development*, 2016.

W

Walker, John M., *China cases insight No. 1: In Qihu v. Tencent, the Chinese Supreme People's Court offers antitrust insight for the digital age*, Stanford Law School China Guiding Cases Project, May 5, 2015.

Wei, Jade W., Ji-Guang Wang, Yining Huang, Ming Liu, Yangfeng Wu, Lawrence K.S. Wong et al., "Secondary prevention of ischemic stroke in urban China," *Stroke*, volume 41, issue 5, May 2010.

West, Darrell M., *Moving forward: Self-driving vehicles in China, Europe, Japan, Korea, and the United States*, Center for Technology Innovation at Brookings, September 2016.

World Bank, *World Development Report 2016: Digital dividends*, 2016.

World Economic Forum, *China's innovation ecosystem*, white paper, August 2016.

World Economic Forum, *The future of jobs: Employment, skills and workforce strategy for the Fourth Industrial Revolution*, Global Challenge Insight Report, January 2016.

World Health Organization, *Global status report on noncommunicable diseases 2014*, 2014.

X

Xie, Paul, *Suning-brick and mortar retailer challenged by e-commerce*, Harvard Business School, November 17, 2016.

Xiufeng, Feng, *Smart grids in China: Industry regulation and foreign direct investment*, The Energy Bar Association, May 16, 2016.

Xu, Ye, Yuanli Liu, Ting Shu, Wei Yang, and Minghui Liang, "Variations in quality of care at large public hospitals in Beijing, China: A condition-based outcome approach," *PLoS One*, volume 10, issue 10, October 2015.

Z

Zhejiang Provincial Government, " 'Once at most': Zhejiang Province to increase efficiency through 'internet plus' social security services in collaboration with the Ministry of Human Resources and Social Security," June 23, 2017 (http://zjzwfw.gov.cn/art/2017/6/23/art_1177809_7819592.html).

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